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ELECTRONIC WARFARE IN ARMY MODELS - A SURVEY.(U)

AUG 80 H P BUSTILLOS, P KUNSELMAN, J B CLARK

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AMSAA
ARMY MATERIEL SYSTEMS ANALYSIS ACTIVITY

CONCEPTS ANALYSIS AGENCY
UNITED STATES ARMY

TECHNICAL REPORT TR-7-79

ELECTRONIC WARFARE IN ARMY MODELS– A SURVEY

AUGUST 1980

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This Survey report presents and synopsizes those models which have been identified as having the capability of representing electronic warfare. The effort covers most, if not all Army models and what is considered a good cross-section of Air Force models that play electronic warfare. All models and simulations are listed alphabetically and indexed by title, purpose, description, electronic warfare capabilities, status, and computer/language used.

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TRASANA TECHNICAL REPORT TR-7-79

ELECTRONIC WARFARE IN ARMY MODELS - A SURVEY

1. PURPOSE

The report documents the results of a comprehensive survey of US Army models, simulations, and wargames that represent some aspect of electronic warfare (EW).

2. BACKGROUND

a. In November 1977, the Vice Chief of Staff expressed concern over the lack of portraying realistic battlefield environmental conditions in the Army materiel acquisition process; in analytical models and studies, and in training, evaluation, and testing programs. In response to this concern, DARCOM and TRADOC formed a joint working group to study the Army's recognition and application of realistic environmental conditions characteristic of today's and tomorrow's battlefield.

b. At a meeting of the DARCOM/TRADOC Battlefield Environment Panel, AMSAA and TRASANA were tasked, with CAA participation, to assess EW representation in Army models and simulations. This document constitutes the joint DARCOM/TRADOC/CAA final report in response to this tasking. The survey was done by a group headed by TRASANA.

3. SCOPE

a. Although the survey was specifically of Army analytical models, system and combat simulations, and wargames that play EW or its effects, some US Air Force models were also included.

b. The task objective was to determine the extent to which EW is represented in the models; however, it was decided at the onset that the adequacy and quality of the modeling would not be assessed in detail due to time and manpower constraints.

4. METHODOLOGY

a. The models were investigated by means of: (1) reviewing already published catalogs (see Appendix A); (2) reviewing specific documentation on some models, as available; and (3) discussing concepts, techniques, and capabilities of certain models with their proponents.

b. A survey of the models was conducted by TRASANA/AMSAA as a means of assessing the capabilities of DARCOM, TRADOC, CAA, and selected Air Force models for representing realistic battlefield conditions (RBCs). Models that play or represent RBCs or their effects were identified, and a questionnaire designed for gathering key information on the models was developed and disseminated.

c. After each completed questionnaire was received, its inputs were analyzed, and a synopsis of the model was developed. Subsequently, each respondent was canvassed whenever possible, to insure that the synopsis was accurate and current. Information cut-off date is April 1980.

5. DISCUSSION

a. General. The models and the data covered herein are intended to reflect only that which was provided through the questionnaires. It is recognized that this document may exclude other Army, Air Force, or contractor models, but this is because the report deals strictly with inputs received from the "community". Moreover, some respondents provided questionnaires for models that do not treat EW; ergo, those models are also excluded.

b. Taxonomy. The models identified in this survey report are categorized as air defense, combined arms, system emulator/simulator, engineering, land forces, and training models. They are listed below according to proponent activity and by the foregoing category or type.

(1) Models by Organization.

US ARMY MATERIEL SYSTEMS ANALYSIS ACTIVITY

DIVLEV
MULTIRADAR
PATCOM
ROLJAM

US ARMY AVIATION R&D COMMAND/CALSPAN

HMSM

US ARMY COMMUNICATION R&D COMMAND

ALLEN
CEESS

US ARMY ELECTROMAGNETIC COMPATIBILITY ANAL CEN

TENIAS

US ARMY ELECTRONIC R&D CMD (CM/CCM)

SAMJAM
SPREAD SPECTRUM

US ARMY ELECTRONIC PROVING GROUND

EIEM

US ARMY ELECTRONIC WARFARE LAB (EWL)

DETAILED ANALYSIS
EOCM SIM FAC
ZAP I
ZAP II

FOREIGN SCIENCE & TECHNOLOGY CENTER

OTOALOC

US ARMY HARRY DIAMOND LABORATORY

ECMFUZ

OFFICE OF MISSILE ELECTRONIC WARFARE

EOCM SIM FAC
SADS VI
ROLSIM
ZAP I
ZAP II

US ARMY MOBILITY EQUIP R&D COMMAND

COMWTH II

US ARMY TECOM

EIEM

US ARMY SATELLITE COMMUNICATION AGENCY

ITF

US ARMY MISSILE COMMAND

AIR DEFENSE
BURST LOCATOR
ICWAR
IHPI
IPAR
IRSS
MGM H4D
MGM H4H
MGM H4B
MSL SEEKER
MSL ARMING
MSL FUZING
RFSS

PM ASE / CALSPAN

HMSM

PM / ROLAND

ROLSIM

PM / TRADE

ARTBASS

PM / PATRIOT

GTSF
H1

PM / DIVAD GUN

DIVAD GUN SIM

US ARMY AIR DEFENSE SCHOOL

CAMPAIGN
COMO III
INCURSION
TACOS

US ARMY COMBINED ARMS COMBAT DEV. ACTIVITY

CORDIVEM
JIFFY

US ARMY INFANTRY SCHOOL

ASARS II

US ARMY COMBINED ARMS TRAINING DEV. ACTIVITY

ARTBASS
BATTLE
CAMMS
CAMMS II
CATTS
DUNN-KEMPF
FIRST BATTLE
PEGASUS
WAR EAGLE

US ARMY TRADOC SYSTEMS ANALYSIS ACTIVITY

ADPAS
BATTLE
CARMONETTE
CASTFOREM
COMO III
DF
FOURCE
RADAR RANGE
SIGINT/EW
TAFSM
TAM

CONCEPTS ANAL AGENCY

CARMONETTE
CEM/TFECS
COMMEL II.5
COMO III
DEWCOM
FORCEM

US ARMY FIELD ARTY

TAM
ICOR

AERONAUTICAL SYS DIV WRIGHT PAT AF BASE

TAGSEM II
TCF

BDM CORPORATION

CLEW II
WARRANT
ICOR

US AIR FORCE PENTAGON

APM
TAC REPELLER
TAC ZINGERS

TAC FIGHTER WPN CEN NELLIS AF BASE

TADBM MPACT TALON

(2) Models by Type.

System Emulator/Simulator

CASTFOREM	ICWAR	MSL ARMING	SADS VI
COMO III	IHPI	MSL FUZING	SAMJAM
DIVAD GUN	IPAR	MULTIRADAR	SPREAD SPECTRUM
ECMFUZ	IRSS	OTOALOC	TAC ZINGERS
EIEM	ITF	PATCOM	TAM
EOCM SIM FAC	MGM-H4D	RFSS	TENIAS
GTSF	MGM-H4H	ROLJAM	ZAP I
HMSM	MSL SEEKER	ROLSIM	ZAP II
H1			

Air Defense

ADPAS	CEM/TFECS	ICOR	PEGASUS
AIR DEFENSE	COMO III	ICWAR	RFSS
APM	CORDIVEM	IHPI	ROLJAM
ASARS II	DEWCOM	INCURSION	ROLSIM
BATTLE	DIVLEV	IPAR	SIGINT/EW
BURST LOCATOR	DUNN-KEMPF	JIFFY	TACOS
CAMMS	EIEM	MGM-H4D	TAC REPELLER
CAMMS II	EOCM SIM FAC	MGM-H4H	TAC ZINGERS
CAMPAIGN	FIRST BATTLE	MGM-H4B	TADBM
CARMONETTE	FORCEM	MPACT II	TAGSEM II
CASTFOREM	GTSF	MSL SEEKER	TALON
CATTS	HMSM	MSL ARMING	TCF
CEESS	H1	MSL FUZING	WAR EAGLE

Land Forces

ADPAS	CEESS	EIEM	TAFSM
ARTBASS	CEM/TFECS	FIRST BATTLE	TAGSEM II
ASARS II	CLEW II	FORCEM	TALON
BATTLE	COMMEL II.5	FOURCE	TCF
CAMMS	COMO III	ICOR	WAR EAGLE
CAMMS II	COMWTH II	INCURSION	WARRANT
CAMPAIGN	CORDIVEM	ITF	ZAP I
CARMONETTE	DEWCOM	JIFFY	ZAP II
CASTFOREM	DIVLEV	PEGASUS	
CATTS	DUNN-KEMPF	SIGINT/EW	

Engineering

ADPAS	GTSF	MGM H4D	ROLJAM
COMO III	HMSM	MGM H4H	ROLSIM
DETAILED ANAL.	H1	MGM H4B	SADS VI
DF	ICWAR	MSL SEEKER	SAMJAM
DIVAD GUN	IHPI	MSL ARMING	SPREAD SPECTRUM
ECMFUZ	IPAR	MSL FUZING	
EIEM	IRSS	RADAR RANGE	
EOCM SIM FAC	ITF	RFSS	

Combined Arms

ADPAS	CASTFOREM	DIVLEV	SIGINT/EW
ARTBASS	CATTS	DUNN-KEMPF	TAGSEM II
BATTLE	CEM/TFECS	FIRST BATTLE	TALON
CARMONETTE	COMMEL II.5	FORCEM	TCF
CAMMS	COMO III	ICOR	WAR EAGLE
CAMMS II	CORDIVEM	INCURSION	
CAMPAIGN	DEWCOM	PEGASUS	

Air Force

ADPAS	CORDIVEM	H1	TAC ZINGERS
APM	DEWCOM	ICOR	TADBM
ARTBASS	DIVLEV	INCURSION	TAGSEM II
CAMMS	EOCM SIM FAC	MPACT II	TALON
CAMMS II	FIRST BATTLE	PEGASUS	TCF
CAMPAIGN	FORCEM	SADS VI	WAR EAGLE
CARMONETTE	FOURCE	SIGINT/EW	WARRANT
CASTFOREM	GTSF	TACOS	
COMO III	HMSM	TAC REPELLER	

Training

ARTBASS	CAMMS	CATTS	FIRST BATTLE
BATTLE	CAMMS II	DUNN-KEMPF	PEGASUS
			WAR EAGLE

c. Analysis/Observations.

(1) In Table 1, the models are listed and categorized according to level of analysis and proponent agency.

(2) A further breakdown of these categories is shown in Table 2, along with the status of each model. The hardware characteristics models are further divided into emulation and analog. Systems effectiveness models are divided into the familiar one-on-one, one-on-many, and many-on-many. Since there are only 5 models that are classified as many-on-one, they are placed under the one-on-one column, and annotated accordingly. Similarly, there is only one few-on-few model, and it is found under the many-on-many column. The combat effectiveness models are presented according to level of conflict simulated; i.e., battalion, division, corps, or theater.

(3) Total EW capability, as defined for the purpose of this report, comprises radar and communications (commo) jamming; radar and commo direction finding; radar and commo listening, i.e., monitoring by receivers; ARM, chaff, and ECCM. The EW capability of models, in alphabetical order, is found in Table 3. The descriptors used are, "E" for explicit, and "I" for implicit. As examples, explicit commo jamming would be the simulating of a commo link with a specific frequency, signal level, and power (or with a net designation), and the simulating of a specific jammer, with its power, model of operation, and location (or probability of jamming vs. range). Implicit commo jamming would be the simulating of the effects of jamming a commo link by merely introducing a time delay. For clarification, the Missile Guidance Models (MGM), under the RADAR JAM column of Table 3, show annotated entries of I for H4D and H4H, and E for H4B. These annotations show that radar jamming is played implicitly for H4D and H and explicity for H4B. In addition, the H4B model plays ECCM explicitly. The descriptors "P" for planned, "F" for future, and "D" for developmental, indicate the status of the capability, and in both cases, implies a future capability.

(4) The same EW capability (as above) is presented in Table 4, by level of analysis (hardware characteristics, systems performance, and combat effectiveness), and by level of conflict. Additional descriptors are shown relative to model status and capability. For example, ARTBASS, under the BATTALION level of combat effectiveness models, is listed as being under development and simulates radar and commo jamming, radar and commo direction finding, and ECCM, all played explicitly.

(5) The elements of combat simulated in each model are shown in Table 5. Using the BATTLE model entry as an example, it can be seen that BATTLE plays ground forces, but only plays helicopters under TAC AIR. It also plays air defense as well as logistics/reserves, and under EW, it only simulates communications jamming (COMJAM).

(6) For the most part, current models are not written in computer simulation languages, but in older, business and scientific languages. This is due primarily to AR 18-1, Management Information System, Policies, Objectives, and Responsibilities, which limits computer language usage to FORTRAN and COBOL. While some of the more detailed engineering and hardware models (that embody significant amounts of mathematical computation) may be efficiently programmed

in business or scientific language, systems performance and combat effectiveness models are more efficient (relative to computer core/storage and actual programming) if written in a simulation language. This could, and occasionally does, pose a problem in any desired expansion of current models. With the advent of the revision of AR 18-1, future models may, hopefully, avoid this.

(7) The survey results listed in Table 6, show that the 77 models covered in the analysis, make use of 16 different name-brand mainframes, and 13 different programming languages.

(8) To briefly describe the extent of EW modeling, a synopsis of each model dealing with any aspect of EW was prepared from the questionnaire. The synopses contain purpose, description, RBC capabilities, model limitations/gaps, data inputs, data requirements, model improvements, comments, point of contact with AUTOVON phone number if government agency, proponent agency, status, and computer and language used. An alphabetical listing of models precedes the synopses which comprise Appendix B.

(9) Data gaps are generally caused by development of models without sufficient regard to the supporting data base required for proper, adequate, and/or efficient use of model resources/capabilities.

(10) Every operational model has its own data base, with its own format. In some cases, these data bases are rather large ones; e.g., CEM/TFECS uses about 25,000 data inputs, COMO III uses over 15,000, and CARMONETTE uses over 10,000.

(11) Each agency controls the development and use of its models without regard for, or dialogue with, other agencies that might have similar models and in some cases, the same model. For example, there are different versions of COMO at TRASANA, CAA, AD School, Kirtland AFB, USAF-Pentagon, and CACDA at Ft Leavenworth.

6. CONCLUSIONS/RECOMMENDATIONS

a. Now that the Army's representation of EW in models has been identified and documented through this report, it is recommended that a dialogue/interface be established among TRASANA, AMSAA, CAA, and such organizations as the Army Model Improvement Program (AMIP), Joint (Army, AF, Marines) EW Center, and SAGA (Studies, Analysis, and Gaming Agency) of the Joint Chiefs of Staff to identify an institutional mechanism for maintaining and periodically publishing an EW model catalog update.

b. It is further recommended that a dialogue/interface be established among TRASANA, AMSAA, CAA, and appropriate high-level groups involved in modeling, to pursue the assessment of the Army's representation of EW in models.

c. Recognizing that plans for improvement of Army models is now the responsibility of the AMIP, recommend that a dialogue/interface be established among TRASANA, AMSAA, CAA, and AMIP, so that a plan of action to address identified gaps be developed.

TABLE 1
CLASSIFICATION LEVEL ONE/PROPONENT

MODEL	HARDWARE CHARACTERISTICS	SYSTEMS PERFORMANCE	COMBAT EFFECTIVENESS
ADPAS		TRASANA LOCKHEED	
AIR DEFENSE		MICOM RAYTHEON	
ALLEN		CORADCOM	
APM		USAF–PENTAGON	USAF–PENTAGON
ARTBASS			CATRADA PM–TRADE
ASARS II		INFSCH	
BATTLE			TRASANA CATRADA
BURST LOCATOR		MICOM RAYTHEON	
CAMMS			CATRADA
CAMMS II			CATRADA
CAMPAIGN			ADS
CARMONETTE		TRASANA CAA	TRASANA CAA
CASTFOREM		TRASANA	TRASANA
CATTS			CATRADA
CEESS		CORADCOM	
CEM/TFECS		CAA	CAA
CLEW II		BDM	BDM
COMMEL II.5		CAA	CAA
COMO III	ADS CAA TRASANA	ADS CAA TRASANA	ADS CAA TRASANA
COMWTH II		MERADCOM	
CORDIVEM		CACDA	CACDA
DETAILED ANALYSIS	EWL	EWL	
DEWCOM		CAA	CAA
DF	TRASANA	TRASANA	
DIVAD GUN		PM–DIVAD	
DIVLEV		AMSAA	AMSAA
DUNN–KEMPF			CATRADA
ECMFUZ	HDL		
EIEM		TECOM EPG	
EOCM SIM FACILITY	OMEW EWL		
FIRST BATTLE			CATRADA
FORCEM			CAA
FOURCE		TRASANA	TRASANA
GTSF	PM–PATRIOT	PM–PATRIOT	
HMSM		PM–ASE CALSPAN	PM–ASE CALSPAN
H1	PM–PATRIOT		
ICOR		USAFAS BDM	USAFAS BDM
ICWAR		MICOM RAYTHEON	
IHPI		MICOM RAYTHEON	
INCURSION		ADS	

TABLE 1 (Cont'd)

CLASSIFICATION LEVEL ONE/PROPONENT

MODEL	HARDWARE CHARACTERISTICS	SYSTEMS PERFORMANCE	COMBAT EFFECTIVENESS
IPAR		MICOM RAYTHEON	
IRSS	MICOM	MICOM	
ITF	SATCOM	SATCOM	
JIFFY			CACDA
MGM–H4D	MICOM RAYTHEON	MICOM RAYTHEON	
MGM–H4H	MICOM RAYTHEON	MICOM RAYTHEON	
MGM–H4B	MICOM RAYTHEON	MICOM RAYTHEON	
MPACT II		TFWC–NELLIS AFB	TFWC–NELLIS AFB
MSL SEEKER	MICOM RAYTHEON		
MSL ARMING	MICOM RAYTHEON		
MSL FUZING	MICOM RAYTHEON		
MULTIRADAR		AMSAA	
OTOALOC	FSTC		
PATCOM		AMSAA	
PEGASUS			CATRADA
RADAR RANGE	TRASANA	TRASANA	
RFSS	MICOM	MICOM	
ROLJAM		AMSAA	
ROLSIM		OMEW PM–ROLAND	
SADS VI		OMEW	
SAMJAM II		ERADCOM–(CM/CCM)	
SIGINT EW		TRASANA CONTRACTOR	
SPREAD SPECTRUM	ERADCOM–CM/CCM		
TACOS		ADS	ADS
TAC REPELLER		USAF–PENTAGON	USAF–PENTAGON
TAC ZINGERS		USAF–PENTAGON	
TADBM			TFWC–NELLIS AFB
TAFSM		TRASANA	
TAGSEM II		ASD WPAFB	ASD WPAFB
TALON			TFWC–NELLIS AFB
TAM		TRASANA USAFAS	TRASANA USAFAS
TCF			ASD WPAFB
TENIAS		ECAC	
WAR EAGLE			CATRADA
WARRANT		BDM	BDM
ZAP 1		OMEW EWL	
ZAP 2		OMEW EWL	

TABLE 2

CLASSIFICATION LEVEL TWO/STATUS

LEGEND: X – Operational Analytical Model T – CPX/Training Model P – Planned Future Model
F – Future Potential Model (1) – One-Sided (2) – Few-on-Few

MODEL	HARDWARE CHARACTERISTICS		SYSTEM PERFORMANCE			COMBAT EFFECTIVENESS			
	ANALOG	EMUL-ATION	ONE-ONE	ONE-MANY	MANY-MANY	BN	DIV	CORPS	THEATER
ADPAS							X		
AIR DEFENSE			MANY-ON-ONE X						
ALLEN				P(1)					
APM					X				X
ARTBASS						P,T ≷ BN			
ASARS II					X	F, < BN			
BATTLE						T			
BURST LOCATOR			X						
CAMMS						T, ≥ BN			
CAMMS II							T		
CAMPAIGN					X		X		
CARMONETTE					X	X			
CASTFOREM					X	X			
CATTS						T			
CEESS			X	X	X				
CEM/TFECS					F			F	F
CLEW II					X		X	X	
COMMEL II.5					X		X		
COMO III		X	X	X	X	X	X	X	X
COMWTH II			X(1)	X(1)					
CORDIVEM							X	X	
DETAILED ANALYSIS			X(1)	X(1)					
DEWCOM							P	P	
DF			X(1)	X(1)					
DIVAD GUN		X	X						
DIVLEV					P		X		
DUNN–KEMPF						T, < BN			
ECMFUZ		X(1)							

(TABLE 2 CONTINUED)

MODEL	HARDWARE CHARACTERISTICS		SYSTEM PERFORMANCE			COMBAT EFFECTIVENESS			
	ANALOG	EMUL-ATION	ONE-ONE	ONE-MANY	MANY-MANY	BN	DIV	CORPS	THEATER
EIEM		X	X	X					
EOCM SIM FAC	X	X	X	X					
FIRST BATTLE							T		
FORCEM									X
FOURCE							X		
GTSF	X(1)		X(1)	X(1)					
HMSM			MANY-ON-ONE X						
H1	X	X		X					
ICOR					X		X	X	
ICWAR		X	X						
IHPI		X	X						
INCURSION			X						
IPAR		X	X						
IRSS	X	X							
ITF	X(1)	X(1)	X(1)						
JIFFY							X	X	X
MGM–H4D	X								
MGM–H4H	X								
MGM–H4B			MANY-ON-ONE X						
MSL SEEKER	X								
MSL ARMING	X								
MSL FUZING	X								
MPACT II					X			X	
MULTI RADAR			MANY-ON-ONE X						
OTOALOC			MANY-ON-ONE X						
PATCOM					P(1)				
PEGASUS						T ≥ BN			
RADAR RANGE			X						

(TABLE 2 CONTINUED)

MODEL	HARDWARE CHARACTERISTICS		SYSTEM PERFORMANCE			COMBAT EFFECTIVENESS			
	ANALOG	EMUL-ATION	ONE-ONE	ONE-MANY	MANY-MANY	BN	DIV	CORPS	THEATER
RFSS	X(1)	X(1)		X(1)					
ROLJAM			*X(1)*	*X(1)*					
ROLSIM			X(1)	X(1)					
SADS VI			X						
SAMJAM II			X(1)	X(1)					
SIGINT/EW								P	
SPREAD SPECTRUM		X (1)							
TACOS			X	X	X	X	X	X	
TAC REPELLER					X(2)				
TAC ZINGERS			X						
TADBM					X			X	
TAFSM							X(1)		
TAGSEM II					X(1)			X	
TALON					X		X	X	
TAM					X(1)				
TCF					X				X
TENIAS				X(1)					
WAR EAGLE								T	
WARRANT				X	X		X		
ZAP I					X				
ZAP II					X				

TABLE 3

EW CAPABILITY OF MODELS

LEGEND: E – Explicit   I – Implicit   P – Planned   D – Developmental   F – Future

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
ADPAS	E	I					E		
AIR DEFENSE	I	I						I	
ALLEN	E	E							
APM	E		I					E	E
ARTBASS	E	E	E	E					E
ASARS II	I	I							
BATTLE		I							
BURST LOCATOR	I							I	
CAMMS		I	I	I				I	E
CAMMS II	I	E		E					E
CAMPAIGN	I								E
CARMONETTE		I							I
CASTFOREM	P	D	P	D	P	D	F	F	P
CATTS		E	I	I					E
CEESS	E	E	E	E	E	E			
CEM/TFECS		I	I	I		I			
CLEW II		E	E	E	E	E			
COMMEL II.5		E		E					E/I
COMO III	E						E		E
COMWTH II	I	I	I	I	I	I	I	I	I
CORDIVEM	P	P	P	P	P	P	F	F	P
DETAILED ANALYSIS	E	E	E	E	E	E		E	E
DEWCOM	E	E	E	E		E	I	I	E/I
DF			E	E					
DIVAD GUN	I							I	
DIVLEV	D	D	D	D	D	D	D	D	D
DUNN–KEMPF		E							
ECMFUZ	E								

(TABLE 3 CONTINUED)

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
EIEM	E	E	E	E	E	E			
EOCM SIM FAC	E								
FIRST BATTLE		E	E	E	E	E		E	
FORCEM	P	P	P	P	P	P	F	F	P
FOURCE		E		E					
GTSF	E	Guidance Loop Jamming						E	E
HMSM	I	Guidance Loop Jamming			RWR			I	
H1	E	Guidance Loop Jamming						E	E
ICOR	I	I	E	E	E	E	E	I	
ICWAR	E							E	
IHPI	I								E
INCURSION	I								E
IPAR	E						Being Developed	E	
IRSS	I								
ITF		E							
JIFFY	I								
MGM–H4D	I								
MGM–H4H	I								
MGM–H4B	E								E
MSL SEEKER	Msl Skr Jam							E	
MSL ARMING	Msl Skr Jam							E	
MSL FUZING	Msl Skr Jam							E	
MPACT II	E	E							E
MULTIRADAR	E								
OTOALOC			E	E	E	E			
PATCOM		E							
PEGASUS		E		E					
RADAR RANGE	E								

(TABLE 3 CONTINUED)

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
RFSS	E								
ROLJAM	E								
ROLSIM	E							E	
SADS VI	E								
SAMJAM II	E							E	
SIGINT/EW	E	E	E	E	E	E			E
SPREAD SPECTRUM		E							
TACOS	E						E		E
TAC REPELLER	E								
TAC ZINGERS	E								
TADBM	E		E	E			E	E	E
TAFSM	E	E	E	E					E
TAGSEM II	I		I				I	I	I
TALON	I	I					I		
TAM	E		E	E					
TCF	I	I	I	I	I	I	I	I	I
TENIAS	E	E							
WAR EAGLE		E	E	E	E	E		E	
WARRANT		E	E	E					E
ZAP 1		I							P
ZAP 2		I							P

TABLE 4

EW CAPABILITY – COMBAT EFFECTIVENESS MODELS – THEATER LEVEL

LEGEND: E – Explicit I – Implicit P – Planned F – Future Potential (I) One-Sided D – Dev

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
APM	E		I					E	E
CEM/TFECS		I	I	I		I			
COMO III	E						E		E
FORCEM	P	P	P	P	P	P	F	F	P
JIFFY	I								
TCF	I	I	I	I	I	I	I		I

(TABLE 4 continued) EW CAPABILITY – COMBAT EFFECTIVENESS MODLES – CORPS LEVEL

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
CEM/TFECS		I	I	I		I			
CLEW II		E	E	E	E	E			
COMO III	E						E		E
CORDIVEM	P	P	P	P	P	P	F	F	P
DEWCOM (P)	E	E	E	E		E	I	I	E/I
ICOR	I	I	E	E	E	E	E	I	
JIFFY	I								
MPACT II	E	E							E
SIGINT/EW (P)	E	E	E	E	E	E			E
TACOS	E						E		E
TADBM	E		E	E			E	E	E
TAGSEM II	I		I				I	I	I
TALON	I	I					I		
WAR EAGLE		E	E	E	E	E		E	

(TABLE 4 CONTINUED) EW CAPABILITY – COMBAT EFFECTIVNESS MODELS – DIVISION LEVEL

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
ADPAS	E	I					E		
CAMMS II	I	E		E					E
CAMPAIGN	I								E
CLEW II		E	E	E	E	E			
COMMEL II.5		E		E					E/I
COMO III	E						E		E
CORDIVEM	P	P	P	P	P	P	F	F	P
DEWCOM (P)	E	E	E	E		E	I	I	E/I
DIVLEV	D	D	D	D	D	D	D	D	D
FIRST BATTLE		E	E	E	E	E		E	
FOURCE		E		E					
ICOR	I	I	E	E	E	E	E	I	
JIFFY	I								
TACOS	E						E		E
TAFSM	E	E	E	E					E
TALON	I	I					I		
WARRANT		E	E	E					E

(TABLE 4 CONTINUED) EW CAPABILITY – COMBAT EFFECTIVENESS MODELS – BATTALION LEVEL

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
ARTBASS (P)	E	E	E	E					E
ASARS II	I	I							
BATTLE		I							
CAMMS		I	I	I				I	E
CARMONETTE	I	I							I
CASTFOREM	P	D	P	D	P	D	F	F	D
CATTS		E	I	I					E
COMO III	E						E		E
DUNN–KEMPF		E							
PEGASUS		E		E					
TACOS	E						E		E

(TABLE 4 CONTINUED) EW CAPABILITY – SYSTEMS PERFORMANCE MODELS – ONE-ON-MANY ANALYSIS

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
ALLEN P(1)	E	E							
CEESS	E	E	E	E	E	E			
COMO III	E						E		E
COMWTH II (1)	I	I	I	I	I	I	I	I	I
DETAILED ANALYSIS	E	E	E	E	E	E		E	E
DF			E	E					
DIVAD GUN SIM (P1)	I							I	
EIEM	E	E	E	E	E	E			
EOCM SIM FAC	E								
GTSF (1)	E	Guidance Loop Jamming						E	E
H1 (1)	E	Guidance Loop Jamming						E	E
RFSS (1)	E								
ROLJAM	E								
ROLSIM (1)	E							E	
SAMJAM II (1)	E							E	
TACOS	E						E		E
TENIAS (1)	E	E							
WARRANT		E	E	E					E

(TABLE 4 CONTINUED) EW CAPABILITY – SYSTEMS PERFORMANCE MODELS – MANY–ON–MANY ANALYSIS

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
APM	E		I					E	E
ASARS II	I	I							
CAMPAIGN	I								E
CARMONETTE	I	I							I
CASTFOREM	P	D	P	D	P	D	F	F	P
CEESS	E	E	E	E	E	E			
CEM/TFECS (F)		I	I	I		I			
CLEW II		E	E	E	E	E			
COMMEL II.5		E		E					E/I
COMO III	E						E		E
DEWCOM (P)	E	E	E	E		E	I	I	E/I
DIVLEV	D	D	D	D	D	D	D	D	D
ICOR	I	I	E	E	E	E	E	I	
PATCOM		E							
TACOS	E						E		E
TADBM	E		E	E			E	E	E
TAGSEM II	I		I				I	I	I
TALON	I	I					I		
TAM (1)	E		E	E					
TCF	I	I	I	I	I	I	I	I	I
WARRANT		E	E	E					E
ZAP I		I							P
ZAP II		I							P

(TABLE 4 CONTINUED) EW CAPABILITY – SYSTEMS PERFORMANCE MODELS – ONE–ON–ONE ANALYSIS

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
BURST LOCATOR	I							I	
CEESS	E	E	E	E	E	E			
COMO III	E						E		E
COMWTH II (1)	I	I	I	I	I	I	I	I	I
DETAILED ANALYSIS (1)	E	E	E	E	E	E		E	E
DF (1)			E	E					
DIVAD GUN SIM P(1)	I							I	
EIEM	E	E	E	E	E	E			
EOCM SIM FAC	E								
GTSF (1)	E	Guidance Loop Jamming						E	E
ICWAR	E							E	E
IHPI	I								E
INCURSION	I								E
IPAR	E						DEV	E	
ITF (1)		E							
RADAR RANGE	E								
ROLJAM (1)	E								
ROLSIM (1)	E							E	
SADS VI	E								
SAMJAM II (1)	E							E	
TACOS	E						E		E
TAC ZINGERS	E								

(TABLE 4 CONTINUED) EW CAPABILITY – SYSTEMS PERFORMANCE MODELS – MANY–ON–ONE ANALYSIS

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
AIR DEFENSE	I	I						I	
HMSM	I	Guidance Loop Jamming			RWR			I	
MISSILE GUIDANCE H48	E								E
MULTIRADAR	E								
OTOALOC			E	E	E	E			

(TABLE 4 CONTINUED) EW CAPABILITY – SYSTEMS PERFORMANCE MODELS – FEW–ON–FEW ANALYSIS

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
TAC REPELLER	E								

(TABLE 4 CONTINUED) EW CAPABILITY – HARDWARE CHARACTERISTICS MODELS – EMULATION

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
COMO III	E						E		E
DIVAD GUN	I							I	
ECMFUZ	E								
EIEM	E	E	E	E	E	E			
EOCM SIM FACILITY (1)	E								
H1	E	Guidance Loop Jamming						E	E
ICWAR	E							E	
IHPI	I								E
IPAR	E						Being Developed	E	
IRSS	I								
ITF		E							
RFSS	E								
SPREAD SPECTRUM (1)		E							

(TABLE 4 CONTINUED) EW CAPABILITY – HARDWARE CHARACTERISTICS MODELS – ANALOG

MODEL	JAM		DF		LISTEN		ARM	CHAFF	ECCM
	RADAR	COMMO	RADAR	COMMO	RADAR	COMMO			
EOCM SIM FAC	E								
GTSF (1)	E	Guidance Loop Jamming						E	E
H1	E	Guidance Loop Jamming						E	E
IRSS	I								
ITF (1)		E							
MGM H4H	I								
MGM H4D	I								
MSL SEEKER	Msl Skr Jam							E	
MSL ARMING	Msl Skr Jam							E	
MSL FUZING	Msl Skr Jam							E	
RFSS	E								

TABLE 5

ELEMENTS OF COMBAT SIMULATED

MODEL	GROUND FORCES	TACTICAL AIR FORCES	AIR DEFENSE FORCES	LOGISTICS/ RESERVE	C^3	ENVIRONMENT	OBSCURATION	EW
ADPAS	X	X	X	X	X	X	X	COMJAM RADJAM
AIR DEFENSE			X		PARTIAL COMMO	TERRAIN ONLY		COMJAM RADJAM Chaff CL
ALLEN					X	X	X	COMJAM RADJAM
APM		X	SAM AD A/C		X			Chaff RADJAM CLUTTER
ARTBASS	X	X	X	X	X	X	X	X
ASARS II	INF ARTY			X	X	TERRAIN ONLY		COMJAM RADJAM
BATTLE	X	HELI-COPTER	X	X	COMMO ONLY	TERRAIN WIND	SMOKE	COMJAM
BURST LOCATOR			X					RADJAM CHAFF CLUTTER
CAMMS	X	X	SAM ADA	X	X	X	X	X
CAMMS II	X	X	SAM ADA	X	X	X	X	X
CAMPAIGN	X	X	X	X	X	X	X	RADJAM
CARMONETTE	X	X	SAM ADA		COMMO	X	X	COMJAM
CASTFOREM	X	X	X	X	X	X	X	X
CATTS	X	X	SAM ADA	X	X	X	X	X
CEESS	X		X	X	X	X		X
CEM/TFECS	X	AGGR	AGGR	X	X	TERRAIN ONLY		COMJAM DF/ LISTEN
CLEW II	X	X			X	X	X	X
COMMEL II.5	ARTY AGGR CA			RESERVE ONLY	X	TERRAIN ONLY		COMJAM DF
COMO III	X	CAS RECON	X		X	X	X	RADJAM ARM CHAFF
COMWTH II	X				X	X	X	X
CORDIVEM	X	X	X	X	X	X	X	X
DETAILED ANALYSIS	X	X			X		X	X
DEWCOM	ARTY AGGR CA	CAS RECON AAH	AGGR	RESERVE ONLY	X	X	X	X
DF	RECON ONLY	RECON ONLY				TERRAIN ONLY		DF
DIVAD GUN						X	X	X
DIVLEV	X	X	X	X	X	X	X	X
DUNN-KEMPF	X	CAS	SAM ADA		X	TERRAIN WIND	SMOKE	COMJAM
ECMFUZ		AIR TGT	PATRIOT MSL					FUZE JAMMING

(TABLE 5 CONTINUED)

MODEL	GROUND FORCES	TACTICAL AIR FORCES	AIR DEFENSE FORCES	LOGISTICS/RESERVE	C^3	ENVIRONMENT	OBSCURATION	EW
EIEM	X		X		X	X	X	X
EOCM SIM FAC		X	X			X	X	IR JAMMER
FIRST BATTLE	X	X	AGGR	X	X	X	X	X
FORCEM	X	X	X	X	X	X	X	X
FOURCE	X	CAS RECON			X	NO WEATHER		COMJAM DF
GTSF		X	X			X		X
HMSM	ARTY	X	X			X	X	RADJAM CHAFF RWR
H1 HYBRID SIM		X	X			X		X
ICOR	X	X	SAM ADA		X	NO WEATHER	X	X
ICWAR			X			TERRAIN ONLY		RADJAM CHAFF CLUTTER
IHPI			X	X				RADJAM CLUTTER
INCURSION	ORGANIC WPNS IN AD ROLE	AIRCRAFT	ORGANIC WPNS IN SAM ADA			X	X	RADJAM
IPAR			X					RADJAM Chaff Arm CLUTTER
IRSS								X
ITF	X	SATELLITE			X	X		COMJAM
JIFFY	X		SAM ADA			X	SMOKE	COMJAM
MGM H4D			X					NO CLUTTER
MGM H4H			X					NO CLUTTER
MGM H4B			X					X
MSL SEEKER			X			X	X	CHAFF SKR JAM
MSL ARMING			X			X	X	CHAFF SKR JAM
MSL FUZING			X			X	X	CHAFF SKR JAM
MPACT II		X	X		X	TERRAIN ONLY		COMJAM RADJAM
MULTIRADAR								X
OTOALOC								X
PATCOM					X	X		X
PEGASUS	X	CAS RECON	SAM ADA	X	X	NO WEATHER	SMOKE	X
RADAR RANGE						NO TERRAIN	X	RADJAM

(TABLE 5 CONTINUED)

MODEL	GROUND FORCES	TACTICAL AIR FORCES	AIR DEFENSE FORCES	LOGISTICS/RESERVE	C^3	ENVIRONMENT	OBSCURATION	EW
RFSS		TGT	MSL		X			X
ROLJAM			X					X
ROLSIM			X					X
SADS VI		X				X		X
SIGINT/EW	X	X	X		X	TERRAIN ONLY		X
SPREAD SPECTRUM					X			COMJAM
TACOS		X	ORGANIC WPNS IN AD ROLE	X	FIRE UNIT LINKS	X	X	RADJAM
TAC REPELLER		AD SUPPRESSION	SAM ADA			TERRAIN ONLY		RADJAM
TAC ZINGERS		CAS,DEEP STRIKE ATTACK	SAM			TERRAIN ONLY		RADJAM
TADBM		X	SAM ADA		X	TERRAIN ONLY		X
TAFSM	X			X	X	X	X	X
TAGSEM II	ARTY RECON	X	SAM ADA	SAM ADA AMMO ONLY		NIGHT WEATHER		RADJAM RADDF ARM CHAFF
TALON	X	X	SAM ADA		X	NO WEATHER		COMJAM RADJAM
TAM		RECON				RAIN TERRAIN		RADJAM DF
TCF	X	X	X	X		TERRAIN		RADJAM
TENIAS					COMMO ONLY	X		COMJAM
WAR EAGLE	X	X	AGGR	X	X	X	X	X
WARRANT	X	X			X	TERRAIN ONLY		X
ZAP 1	X				COMMO ONLY	WEATHER TERRAIN	X	COMJAM
ZAP II	X				COMMO ONLY	WEATHER TERRAIN	X	COMJAM

TABLE 6

COMPUTER/LANGUAGE USED BY MODEL

MODEL	COMPUTER	LANGUAGE
ADPAS	UNIVAC 1108	FORTRAN V
AIR DEFENSE	CDC 6700	FORTRAN
ALLEN	IBM 360/65 OR INTERDATA 8/32	FORTRAN
APM	IBM 370	FORTRAN
ARTBASS	TBD	FORTRAN
ASARS II	CDC 6400	FORTRAN IV
BATTLE	WANG	BASIC
BURST LOCATOR	CDC 6700	FORTRAN
CAMMS	TBD	FORTRAN
CAMMS II	TBD	FORTRAN
CAMPAIGN	CDC 6400	FORTRAN IV
CARMONETTE	UNIVAC 1108	FORTRAN V
CASTFOREM	DEC VAX 11/780, UNIVAC 1100/82	SIMSCRIPT II.5
CATTS	ZEROX SIGMA 9	FORTRAN
CEESS	IBM 370/165	COBOL/FORTRAN
CEM/TFECS	UNIVAC 1108	FORTRAN V
CLEW II	CDC 6600, 7600, CYBER 176	FORTRAN IV
COMMEL II.5	UNIVAC 1108	FORTRAN V
COMO III	UNIVAC/CDC	FORTRAN V/IV, COMPASS
COMWTH II	CDC 6600	FORTRAN IV
CORDIVEM	DEC VAX 11/780, UNIVAC 1100/82	FORTRAN
DETAILED ANALYSIS	HP 9830, BURROUGHS 5700 INTERDATA 8/32	BASIC/FORTRAN
DEWCOM	UNIVAC 1108	SIMSCRIPT II.5
DF	UNIVAC 1108	FORTRAN V
DIVAD GUN SIM.	CDC CYBER	FORTRAN
DIVLEV	CDC 7600	FORTRAN IV
DUNN–KEMPF	MANUAL	N/A
ECMFUZ	PRIME	FORTRAN IV
EIEM	CDC 6000, 7000, CYBER	EXTENDED FORTRAN ASSEMBLER
EOCM SIM. FAC	EAI PACER 100 EAI 7800 ANALOG EAI 3200	FORTRAN IV, HYBRID OPNS INTERPRETER, ASSEMBLER
FIRST BATTLE	MANUAL	N/A
FORCEM	UNIVAC 1100/82	FORTRAN V
FOURCE	UNIVAC 1108	FORTRAN V, ASSEMBLER
GTSF	CDC 6700, COMCOR 5000 DATACRAFT 6024/5	FORTRAN
HMSM	IBM 370/65	FORTRAN IV
H1	COMCOR 5000 ANALOG CDC 6700	FORTRAN IV, EXT FORTRAN
ICOR	CDC 7600 CDC CYBER 176	FORTRAN IV

(TABLE 6 CONTINUED)

MODEL	COMPUTER	LANGUAGE
ICWAR	CDC 6700	FORTRAN IV
IHPI	CDC 6700	FORTRAN IV
INCURSION	CDC 6400	FORTRAN IV
IPAR	CDC 6700	FORTRAN IV
IRSS	INTERDATA 70 CDC 6000	FORTRAN
ITF	PDP–8/HP2112	ANSI FORTRAN, SPEC FORTRAN
JIFFY	CDC 6400/6500	FORTRAN
MGM H4D	CDC 6700 CI 5000 ANALOG	FORTRAN IV AND ASSEMBLY
MGM H4H	CDC 6700 CI 5000 ANALOG	FORTRAN IV AND ASSEMBLY
MGM H4B	CDC 6700 CI 5000 ANALOG	FORTRAN IV AND ASSEMBLY
MSL SEEKER	CDC 6700	FORTRAN IV
MSL ARMING	CDC 6700	FORTRAN IV
MSL FUZING	CDC 6700	FORTRAN IV
MPACT II	IBM 370	FORTRAN IV
MULTIRADAR	UNIVAC 1108	FORTRAN V
OTOALOC	WANG 2200	BASIC
PATCOM	CDC 7600	EXTENDED FORTRAN
PEGASUS	MANUAL	N/A
RADAR RANGE	UNIVAC 1108	FORTRAN V
RFSS	DATACRAFT 6024/1, /6 INTERDATA 80 AND 85	FORTRAN, ASSEMBLER
ROLJAM	CDC 7600	FORTRAN
ROLSIM	CDC 7600	FORTRAN
SADS VI	PDP 11/34, NOVA 1210	RT-II, FORTRAN
SAMJAM II	UNIVAC/IBM	FORTRAN V/IV
SIGINT/EW	TBD	TBD
SPREAD SPECTRUM	IBM 360	FORTRAN IV
TACOS	CDC 6500	FORTRAN IV
TAC REPELLER	HONEYWELL MULTICS, IBM 3032, CDC CYBER 176	FORTRAN
TAC ZINGERS	HONEYWELL MULTICS, IBM 3032, CDC CYBER 176	FORTRAN
TADBM	CDC 6400, 6600, IBM 360	FORTRAN IV
TAFSM	UNIVAC 1108	FORTRAN V
TAGSEM II	CDC 6600	FORTRAN IV
TALON	CDC CYBER 74	FORTRAN IV
TAM	UNIVAC 1108 /CDC 6400	FORTRAN V /IV
TCF	CDC 6600	FORTRAN IV
TENIAS	UNIVAC	FORTRAN V
WAR EAGLE	MANUAL	N/A

(TABLE 6 CONTINUED)

MODEL	COMPUTER	LANGUAGE
WARRANT	CDC 7600/6600	FORTRAN
ZAP I	IBM 360/65, AMDAHL 470–V5	FORTRAN
ZAP II	IBM 360/65	SIMSCRIPT II.5

APPENDIX A

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APPENDIX B

SYNOPSES

TABLE OF
CONTENTS

AIR DEFENSE PENETRATION AND ATTACK SIMULATION (ADPAS) MODEL

1. PURPOSE

To determine the survivability of an aerial platform against ADA, aerial interceptors and electronic warfare.

2. DESCRIPTION

ADPAS is a two-sided, deterministic, division-level simulation that can play up to 300 aircraft. It accounts for the C^3 function and has a target acquisition capability which can be used to assess the effectiveness of sensors at the engineering level.

3. RBC CAPABILITIES

Model plays RED/BLUE communications jamming implicitly and RED/BLUE radar jamming explicitly. Relative to weather, the model can play rain, fog/haze, and snow/sleet. It can simulate nighttime with full moon and twilight, smoke and dust as they affect the target acquisition capability of an RPV-type device/weapon, as well as explicit terrain, specifically, site altitude. ADPAS plays all obscurants as a function of degradation to the weapon system's ability to penetrate or "see" through them. Jamming is played in the form of time delays or complete blockage. This is done by comparing power output versus receiver sensitivity and on-board jamming with both spot and broad-band jamming available for both RED and BLUE. Jammer on/off times are input parameters.

4. MODEL LIMITATIONS/RBC GAPS

Smoke, obscurants and communications jamming are all played in terms of degradation factors, i.e., not in detail. Cannot play both RED/BLUE ADA sites simultaneously. Does not play DF, Chaff, ARMs or ECCM against communications/radar jamming, nor against incidental or deployed smoke.

5. INPUTS AND SOURCES

INPUT	SOURCE
WPN characteristics	TRADOC, FTC, DIA
A/C characteristics	USAF, AVRADCOM
Scenario, terrain	CAC, TRASANA
Radar characteristics	ARRADCOM
Flight profiles	TSMs
Jammer characteristics	ERADCOM, FSTC
Weather	USAF, SCORES

6. REQUIREMENTS

None identified.

7. MODEL IMPROVEMENTS

Improvements in the area of firing doctrine (SAM, AAA) are in progress and will incorporate any changes in the radar acquisition of targets from improved/postulated AAA weapons. Also the new/postulated SAM systems and their firing doctrine are being investigated for possible incorporation.

8. COMMENTS

ADPAS is a proprietary model, its use being controlled by Lockheed. Model was used by TRASANA through a contract with Lockheed since it was the only model that could provide the data required for an air survivability study being conducted by TRASANA on the RPV system. Lockheed is prime contractor for the RPV system.

CONTACT: W. John Peterson
AUTOVON thru Moffet Field 359-3110
Commercial A/C (408) 742-3179

STATUS: Operational

AGENCY: Lockheed Missiles and Space Co, Inc.
Tactical Systems Engineering
1111 Lockheed Way
Sunnyvale, CA 94088

COMPUTER: UNIVAC

LANGUAGE: FORTRAN V

AIR DEFENSE MODEL

1. PURPOSE

To define HAWK effectiveness for a broad range of system configurations and attack tactics.

2. DESCRIPTION

The Air Defense model is a digital computer program used for simulating a variety of attack tactics against an Improved HAWK system at the battery level. The model considers the Improved HAWK battery, Improved HAWK Assault Fire Unit, and potential new items.

3. RBC CAPABILITIES

Conditions modeled include explicit representation of terrain in the way of land form, chaff, radar jamming, and partial communications jamming. Barrage or spot noise jamming of a given power spectral density is an input. Jamming range is fixed for standoff jamming and the same as that of the penetrating aircraft for self-screening jamming. Deceptive jamming is modeled as a fixed value of jam-to-signal ratio at the same range as the penetrating aircraft. During a given run, jamming is either on or off, i.e., no provision for start/stop jamming. In the case of standoff jamming, the target range is compared to the range at which the single-scan probability of detection is 0.50 (R50). Different values of R50 are used, depending on whether the standoff jammer is main beam, near side lobes, or far side lobes. Standoff jamming limits detection range on a quiet penetrator, self-screening jamming alters system response time, and deceptive jamming alters missile Pk.

4. MODEL LIMITATIONS/RBC GAPS

Does not address DF, weather or obscurants; however, the model has no significant limitations, relative to its current use. The assumptions are reasonable approximations to more precise system characteristics, e.g., missile flyout time, radar detection, etc.

5. INPUT

Model inputs include HAWK system and configuration parameters which are derived from lab, field and theoretical sources; target flight paths, velocity, and altitude that are defined for a given study or are theoretical, and ECM environment parameters that are defined for a given study or are theoretical.

6. REQUIREMENTS

There is adequate knowledge for refining and updating the model.

7. MODEL IMPROVEMENTS

Model refinements under development are detection accuracy improvement, varied threat tactics, and output options.

CONTACT: Charles Lewis AV 746-5470

AGENCY: MICOM, Redstone Arsenal, AL

STATUS: Operational

COMPUTER: CDC 6700

LANGUAGE: FORTRAN

8. COMMENTS/RECOMMENDATIONS

Model information was furnished by Systems Engineering, Tactical Ground Defense Systems (TGDS) Raytheon Company, Bedford, MD 01730

ALLEN MODEL

1. PURPOSE

The Allen model performs synthesis and analysis of electromagnetic compatibility/electromagnetic vulnerability (EMC/EMV) problems.

2. DESCRIPTION

The model consists of 12 interconnected computer programs, each performing a distinct and special function; either utility routines, data file manipulation/processing routines, or analysis routines. In addition to these 12 programs, several other peripheral programs are used to generate input data. Examples include emission spectrum generation and frequency allocation. Model is capable of handling all emitters and receptors of electromagnetic energy in any generic category, regardless of side.

3. RBC CAPABILITIES

The environmental parameters represented in the model are as follows: explicit communications and radar jamming; implicit rain, fog, haze, snow and sleet; explicit land form; and implicit vegetation and cultural features. Obscurants are not addressed at all.

4. MODEL LIMITATIONS/RBC GAPS

Frequency hopping equipment cannot be accommodated.

5. INPUT

Equipment position (X,Y,Z) coordinates and netting/connectivity for all C-E equipment locations, emission spectra, transmitter power, antenna pattern, receiver RF/IF selectivity, receiver sensitivity, and receiver performance criteria.

6. REQUIREMENTS

Due to model being rewritten for new computer facility, data requirements are not yet defined.

7. MODEL IMPROVEMENTS

See paragraph 6 above.

8. COMMENTS

CONTACT: Paul A. Major AV 995-4605

AGENCY: CORADCOM

STATUS: Currently unusable at CORADCOM (See para 6. above)

COMPUTER: IBM 360/65 or Interdata 8/32

LANGUAGE: FORTRAN

ADVANCED PENETRATION MODEL (APM)

1. PURPOSE

The APM is a theater-level, complex, digital simulation of an enemy war order conflict between US penetrators and enemy defenses. It is used to identify force structures that are most effective against a range of defenses. The model was developed by Boeing Computer Services, with its first major operational application undertaken in the Joint Strategic Bomber Study in late 1972.

2. DESCRIPTION

The model can track individual penetrators from launch through AWACS, EW, GCI, and interceptor SAM coverage and from the target areas to recovery bases. It models each penetrator's exposure to radar, calculates the results of any engagement that occurs, and then aggregates the results for the entire force. The model has two main parts: the Mission Planner, where the user specifies his force structure; and the Air Battle, where the APM executes the battle and lists the results. The Mission Planner has modules that produce routing from launch bases to entry points outside of the enemy defenses, provide any refueling required, schedule targets possible within fuel constraints, and route from the defended area to recovery bases. The Air Battle simulation is a time-sequenced processing of the events that have been generated in the Mission Planner and Air Battle pre-processors. An event such as "enter radar coverage" will usually generate a "radar detects penetrator" event. This detection event will cause the "request fighter" event to be generated, which may lead to a fighter intercept. The information associated with these events is output in the form of output event notices (OENs) and is presented in tabular form to the user. Offensive weapons comprise bombers, tankers, decoys, air launched cruise missiles, SRAM, bombs and precursor missile attack. The defensive systems that can be modeled include AWACS, GCI and EW radars, filter centers, fighter bases, fighter caps, and C^2 nets that tie these together. Also includes SAM sites and target complexes.

3. RBC CAPABILITIES

The model can represent BLUE jamming RED radars explicitly, as well as BLUE chaff and BLUE/RED ECM. The Air Battle simulation contains several types of event processors, one of which is the radar processors. It is here where ECM is modeled as noise. A bomber entering radar coverage will jam that radar with a noise strobe if the bomber is equipped with proper ECM. The RBC apply mainly to the Air Battle.

4. MODEL LIMITATIONS/RBC GAPS

The model does not represent weather, obscurants, terrain, or ground combat elements. It does model communications jamming, DF, ARM or other CCM.

5. INPUTS AND SOURCES

INPUT	SOURCE
RED ground radar characteristics	FTD/DIP
BLUE jammer characteristics	Tech Manual, Aircraft
Interceptor characteristics	DIP
AD weapon types/characteristics	FTD/DIP
Maximum no. of committed fighter/interceptors	User input
Radar perf. factor in clutter	FTD/DIP
Chaff characterisitics/effects parameters	US technical data
Scenario/location of BLUE weapons/penetrator	User input
ECM input for table lookup	US tech. data/Intell
RED scenario	FTD/DIP, Intell/user input

6. REQUIREMENTS

Current data being used is adequate to satisfy requirements.

7. MODEL IMPROVEMENTS

Three to six contractor personnel have been assigned continually to the APM since Air Force acceptance in 1972. Some of the requirements of the current contract are to improve the modeling of performance of penetrators and the module that nets the command and control.

CONTACT: CPT Joseph Smart AV 225-4544

AGENCY: Bomber Division, Dir for Strategic Force Studies, ACS of Studies and Analysis, HQ AF, Pentagon

STATUS: Operational

COMPUTER: IBM 370

LANGUAGE: FORTRAN

8. COMMENTS AND RECOMMENDATIONS

The APM has been given to SAC and is being used in 1980 studies. The model will be useful in the analyses of studies as long as the APM software is maintained to fully utilize the available hardware, meet user requirements, and as long as the US has airbreathing penetrators.

ARMY TRAINING BATTLE SIMULATION SYSTEM (ARTBASS)

1. PURPOSE

To train commanders and staffs of maneuver companies and maneuver battalions in the control and coordination of combined arms operations and to enable them to attain and sustain or exceed ARTEP standards. The brigade commander and his staff will participate as the headquarters for controlling the battalions being so exercised.

2. DESCRIPTION

The model will permit the application and coordination of firepower, to include direct/indirect fires, AFCAS, Army aerial weapons, and AD fires. It will incorporate movement, and tactical maneuver, and interactive battlefield/terrain modifications; create an environment where battalion command groups can exercise their SOPs and techniques for C^3 in tactical situations; emphasize the dynamics of logistics and administration in the combat zone; and allow for the collection of combat information and the use of intelligence gathering assets available to develop combat intelligence. Finally, the model will include various types of weather and their effects, and EW aspects.

3. RBC CAPABILITIES

The model can play radar/communications jamming, DF, obscurants, weather and any terrain area for which data is available from Defense Mapping Agency. The CCM is unit SOP dependent, i.e. radio silence, ECCM pod used to defeat AD, etc.

4. MODEL LIMITATIONS/RBC GAPS

Since the model prototype is under development, limitations/gaps are not yet identified.

5. INPUT

TBD

6. REQUIREMENTS

TBD

7. MODEL IMPROVEMENTS

TBD

8. COMMENTS

CONTACT: LTC Frank McGurk AV 552-3189/2075

AGENCY: CATRADA, Ft Leavenworth, KS

STATUS: Developmental

COMPUTER: TBD

LANGUAGE: FORTRAN

(ASARS II) ARMY SMALL ARMS REQUIREMENTS STUDY II BATTLE MODEL

1. PURPOSE

Model was developed by Combat Developments Command, Systems Analysis Group, Ft Belvoir, VA in 1973 to provide a tool for evaluating the operational effectiveness of small arms, tactics, and organizational parameters of a small infantry unit, i.e., less than company size (reinforced platoon).

2. DESCRIPTION

ASARS is a two-sided, force-on-force, stochastic model that portrays the basic functions of observation, movement, firing, and commmunications. The subroutines associated with these four functions and a suppression subroutine are all controlled by an executive routine. Detection levels are based on terrain and vegetation, line of sight, firer suppression, movement of firer or target, range, firing signatures, assigned sectors of responsibility, previous detections, and communicated knowledge. Movement of maneuver unit leaders involves a detailed route selection process that considers terrain, vegetation, cover and concealment, knowledge of the enemy, and mission of the group. Other unit members move individually but are constrained by unit formations. Small arms rounds are traced individually from weapon to specific body part impact for determining kills. Indirect-fire kills are determined probabilistically for specific weapon/target conditions. Communication nets are employed for transferring voice, wire, hand-signal, radio, seismic sensor, and MTI radar messages. Suppression from direct and indirect fire is played and results in the degradation of observation, movement, and firing functions.

3. RBC CAPABILITIES

Macro-terrain and micro-environment are used to portray the battlefield. Terrain cells of 12.5-meter resolution are split into two triangular planes using a randomly assigned diagonal. The micro-environment specifies characteristics of vegetation areas in terms of densities and types (12 classes), soil types (4 classes) and the presence of mines. Though communications and radar jamming are not played currently, it is felt that they could easily be included. The CCM, obscurants, and weather effects could similarly be included.

4. MODEL LIMITATIONS/RBC GAPS

Model is very complex and lengthy, requiring extensive personnel and computer resources. It is limited strictly to dismounted infantry studies. Explicit representation of EW, weather, obscurants, light level, night operations, and CCM is not modeled mainly because requirements to modify/augment model have not made/placed on proponent.

5. INPUTS AND SOURCES

INPUT	SOURCE
Terrain	DMA
Indirect-fire weapons performance characteristics	AMSAA
Direct-fire weapons performance characteristics	AMSAA
Pos, loc. org. of RED/BLUE units	CORES, Internal
Human factors	Internal
Communications commo time delays	MASSTER Tests
Radar (MTI) characteristics	MASSTER Tests
Sensor characteristics	MASSTER Tests

6. REQUIREMENTS

Data required thus far has been adequate in quantity and quality.

7. MODEL IMPROVEMENTS

Reduce model running time, and incorporate explicit representation of EW, smoke, and crud.

CONTACT: Mrs. Jody Shirley AV 835-1989

AGENCY: Directorate of Combat Developments, Infantry School, Ft Benning

STATUS: Operational

COMPUTER: CDC 6400

LANGUAGE: FORTRAN IV

BATTALION ANALYZER AND TACTICAL TRAINER FOR LOCAL ENGAGEMENTS (BATTLE) MODEL

1. PURPOSE

BATTLE is a computer-assisted wargame developed for the Commander, V Corps, (Germany) to provide battalion commanders the means for assessing the effectiveness of selected battalion fighting positions, weapon employments, and training of battalion-and company-level personnel.

2. DESCRIPTION

BATTLE is an open, two-sided, time-preserving, computer-assisted, Monte Carlo, manual wargame played on a three-dimensional terrain board with resolution to the individual weapon system level. It uses a mini-computer to calculate results of direct and indirect fire engagements and perform book-keeping functions. A BATTLE exercise is played with a real-time ratio of 20:1 or greater and can simulate combat situations of from two opposing tanks up to a battalion task force opposed by a full Warsaw Pact motorized rifle division.

3. RBC CAPABILITIES

BATTLE can play communications jamming implicitly; however, it can play almost any RBC if data is available. Some RBCs are input using current software; others require significant modification or can be played externally (manually) by manipulating game rules. It plays deliberate smoke (self-screening and artillery-delivered) to the extent of cloud growth/decay and wind factors. Terrain is explicit (terrain board).

4. MODEL LIMITATIONS/RBC GAPS

Line-of-sight and range calculations are manual. Radar jamming, DF and chaff are not played. Weather is not considered. Model does not play light levels nor night operations. There is no CCM presented.

5. INPUTS AND SOURCES

INPUT	SOURCE
Weapon operational characteristics	AMSAA, BRL
Hit probababilities	AMSAA
Kill probabilities given a hit	AMSAA
Lethal area - indirect fire	BRL
Mine characteristics	TRASANA
Prob of mine activation	TRASANA
Prob of mine being a dud	TRASANA

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Aerosol	Non-existent
Dust/debris	Non-existent
Fog/haze	Insufficient quantity
Rain/snow	Non-existent
Communications	Insufficient quantity

7. MODEL IMPROVEMENTS

Release 3 will incorporate CAS, improved second round hit probabilities, ability to fire more than one weapon from a single platform, GSRS, different fire mission routines, ability to resurrect a system killed erroneously, and CBR.

CONTACT: LTC G. Flack AV 258-2937

AGENCY: TRASANA

STATUS: Operational

COMPUTER: WANG

LANGUAGE: BASIC

BURST LOCATOR MODEL

1. PURPOSE

To estimate the first and subsequent intercept ranges against a certain attack with all targets in the raid at the same initial range, speed, and altitude and heading radially towards the battery.

2. DESCRIPTION

The model is a digital computer program that simulates the target intercept portion of the improved HAWK system. The model represents battery-level operations.

3. RBC CAPABILITIES

The conditions considered are the implicit representation of radar jamming, rain, fog/haze, snow/sleet, smoke, dust and terrain, as land form and vegetation.

4. MODEL LIMITATIONS/RBC GAPS

Only non-maneuvering penetrators are considered, and only part of the engage phase of the engagement is modeled.

5. INPUT

Model inputs specify system response time (time from detection by an acquisition radar to first missile launch), transfer time (time from intercept of one target to next missile launch at another target in the raid), target altitude, target speed, and range at which the raid was initially detected. Most inputs are generated by MIA and provided by MIRCOM. Other agencies such as DIA also provide inputs.

6. REQUIREMENTS

None Identified.

7. MODEL IMPROVEMENTS

Improvements are not currently planned for this model.

CONTACT: Charles Lewis AV 746-5470

AGENCY: MICOM, Redstone Arsenal AL

STATUS: Operational

COMPUTER: CDC 6700

LANGUAGE: FORTRAN

8. COMMENTS/RECOMMENDATIONS

Model information was provided by Systems Engineering, Tactical Ground Defense Systems (TGDS) Raytheon, Bedford, MA, 01730.

COMPUTER ASSISTED MAP MANEUVER SIMULATION (CAMMS) MODEL

1. PURPOSE

To provide training for battalion and brigade command groups. It portrays a battle situation on a control board from platoon/section through battalion. All levels of play require four computer terminal operators. Eight controllers are required at battalion level and 11 are required at brigade level.

2. DESCRIPTION

The model is a one-sided, probabilistic, computer-assisted battle simulation. It contains a TO&E data base (H-Series TO&E) consisting of armor, infantry, airborne, mech, and cav (regiment and division) up to brigade level with associated combat support and combat services support elements. The simulation assesses the result of direct fire conflicts as well as those mentioned above.

3. RBC CAPABILITIES

The model plays RED communications jamming and RED/BLUE DF/chaff implicitly. Most weather conditions and obscurants, to include wind and cloud cover, are played implicitly. Terrain is played explicitly. Jamming is directed mainly at the brigade command nets and fire control nets. The CAMMS also plays air-delivered chaff implicitly. The CCM is governed by unit SOPs.

4. MODEL LIMITATIONS/RBC GAPS

No radar jamming played in the model. Air ordnance is not available. No means to attrite personnel other than as a result of enemy action. No means to attack POL other than conflict. ADA has no ground-to-air capability. There is no fuze setting on ammo type in artillery play - HE is used 100 percent. Current version does not have explicit smoke capability. It is handled probabilistically, i.e. computer provides on-line comment "Smoke is effective" or "Smoke is ineffective." Rain is not used as a weather observation factor, neither is dust.

5. INPUTS AND SOURCES

INPUT	SOURCE
Weapons file	FMs, AMSAA, TRADOC
TO&E data base file	H-Series TO&E
Weather data	Weather Reports - WES, SCORES
Jammer parameters	E - War
Terrain/mobility data	DMA

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Smoke	Unvalidated
Dust	Unvalidated
Fog/haze	Unvalidated
Rain/snow	Unvalidated

7. MODEL IMPROVEMENTS

Battle and summary programs; incorporation of CAMMs into CAMMS II; and smoke module, EW module, weather, and visibility range versus weather conditions.

CONTACT: LTC Jimmie J. Heathman AV 552-3395/3180

AGENCY: CATRADA, Ft Leavenworth, KS

STATUS: Operational

COMPUTER: TBD

LANGUAGE: FORTRAN

CAMMS II MODEL

1. PURPOSE

To train and exercise staffs at battalion through division level. It can also be played at various levels of maneuver units (platoon through battalion).

2. DESCRIPTION

The model is a two-sided, probabilistic, computer-assisted, division-level, free-play battle simulation. It contains a TO&E data file consisting of armor, mech infantry, airborne, and air mobile divisions with associated combat support and combat services support units. It provides for organization for combat, i.e. cross-assignment, attachment, etc. It contains functions to exercise air, air defense, artillery, intelligence w/sensors, electronic warfare, admin, logistics, and nuclear/chemical weapons. It assesses the result of direct fire and the above functions in terms of personnel/equipment losses. It maintains summary/historical file for exercise critiques.

3. RBC CAPABILITIES

The model plays a DF capability based on unit resources and manhours available. Time duration of jamming is a function of jammer assets/capability available and efforts taken to counter the jamming. The DF is used to locate and target the communications emitters/units. Once located, a player decision is made to jam or destroy. If a unit is jammed, both its mobility and firepower are degraded. Jamming may be countered by changing frequency or location. Radar jamming is played in the same manner as radio jamming. Weather and terrain factors are used to degrade combat and mobility capability. The CCM played is against communications jamming in the form of frequency hopping or relocation of communications emitter.

4. MODEL LIMITATIONS/RBC GAPS

The model does not play chaff, wind, or cloud cover. The CCM versus radar jamming is not represented. Having to use unclassified data base is considered a limitation by users.

5. INPUTS AND SOURCE

INPUT	SOURCE
TO&E file (data base)	H series TO&E
Weapons file	FM, DIVAD Study, FIRST BATTLE
Conflict	CAMMS/Einfield Study
E-War (electronic) jamming, DF'ing, location capability	FIRST BATTLE - Electronic Warfare Supplemental Rules

CAS	FIRST BATTLE prototype AD module
Artillery (steel, nuc, chem)	Artillery Center
Intel (gross sys perf parameters/characteristics)	WAR EAGLE/FIRST BATTLE
3 terrain categories	Maps
10 weather categories	Weather data reports

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Smoke	Unvalidated/non-existent
Dust	Unvalidated/non-existent
Fog/haze	Unvalidated/non-existent
Rain/snow data in terms of impact on firepower capability and mobility.	Unvalidated/Non-existent

7. MODEL IMPROVEMENTS

a. Expansion to corps level

b. Additional CSSD

c. Use of classified data as an option to be considered.

8. COMMENTS

CONTACT: LTC Carlile AV 552-4669/3395/3180

AGENCY: CATRADA, Ft Leavenworth, KS

STATUS: OPERATIONAL

COMPUTER: TBD

LANGUAGE: FORTRAN

CAMPAIGN SUBMODEL OF ADAGE MODEL

1. PURPOSE

CAMPAIGN is a many-on-many, expected-value submodel of the Air Defense Air-to-Ground Engagement (ADAGE) Model. It was developed to support the Division Air Defense Gun Cost and Operational Effectiveness Analysis. Emphasis is on the attack of targets by small raids of enemy aircraft. The model's objective is to measure the effectiveness of the air defense over time by determining the enemy A/C destroyed, the ground assets preserved, AD weapons remaining, ammunition expended, as well as friendly aircraft remaining.

2. DESCRIPTION

CAMPAIGN is a two-sided computer model used in studying the effectiveness of mixes of BLUE ground-based weapons in an air defense role. CAMPAIGN receives input from INCURSION model in the form of effectiveness for each ground-based weapon type. The model gives enemy aircraft the capability to optimally allocate targets, choose the profile to and from the target, and select the ordnance and delivery profile at the target if it is in accord with the ingress and egress of the aircraft. RED aircraft attack selected BLUE ground targets with a specified number of raids. Up to 16 RED A/C fly together to form one raid. All raids flown together in the air attack on the BLUE division form a RED wave which may be repeated during the day according to input. Attack waves are optimally reallocated daily based on the opposing force existing and the RED commander's priorities. Attrition of RED AF is accomplished by BLUE ADA and AF; attrition of BLUE AF is accomplished by the RED AF only. No attack of RED ground forces by BLUE air force occurs, and no RED ground-based air defense is played. BLUE ground force attrition is accomplished by RED ground attack aircraft and ground war losses from SCORES scenario wargaming results. RED ground forces, however, are not explicitly portrayed. In addition, repair and refurbishment of ground targets and BLUE air defense weapons, daily reinforcement of the BLUE and RED aircraft inventories, and ammunition basic loads and resupply may be considered in the CAMPAIGN model.

3. RBC CAPABILITIES

The RBCs played implicitly, using parametric inputs are red radar jamming, rain, fog/haze, snow/sleet, cloud cover, night, smoke, dust, and terrain. Additional data desired for more detailed representation of these and other RBCs is noted in paragraph 5 below. The RBC effects are introduced through Incursion model output and the RED aircraft tactics limitations. Weather can be represented by any meteorological visibility range and ceiling (cloud cover) values.

4. MODEL LIMITATIONS/RBC GAPS

No explicit communication links or command and control are played in the model. However, implicit effects on C^3 can be played parametrically. The only RBCs played are those introduced into CAMPAIGN through effectiveness

data provided by Incursion and inputs that represent RED aircraft tactics. CAMPAIGN is not a stand-alone model; it requires weapon system effectiveness inputs from Incursion.

INPUT	SOURCE
Threat scenario	Threat Division ADS
BLUE ADA scenario	Studies Branch ADS
RED air-to-BLUE ground damage	AMSAA
Ground battle data	SCORES, CACDA
Air-to-air exchange/attrition data	OSD, PA&E
Air defense system effectiveness data	Incursion model

5. REQUIREMENTS

REQUIREMENTS:	AVAILABILITY/INTEGRITY:
Aerosols Smoke Dust Debris Fog/Haze Rain Snow	Data should represent the effects of these atmospheric conditions quantified and related to the performance of aircraft tactics, the effectiveness of gunner/pilot, as well as the effectiveness of the ADA weapon system.

6. MODEL IMPROVEMENTS

Model has been expanded to simulate dual-ammunition capable air defense systems. ADP refinements to the model are made on a continuing basis.

CONTACT: Chas Anderson AV 978-6238

AGENCY: ADS Ft Bliss

STATUS: Operational Active

COMPUTER: CDC 6400

LANGUAGE: FORTRAN IV

7. COMMENTS/RECOMMENDATIONS

The ADAGE (INCURSION/CAMPAIGN) Model simulates a division area encounter and is used for studies/analyses which require numerous runs where many alternatives must be considered. Due to these applications, those modifications that address limitations/RBC gaps should be defined, reviewed, and perhaps programmed through the TRADOC model improvement program.

CARMONETTE MODEL

1. PURPOSE

CARMONETTE, originally developed by Research Analysis Corporation of McLean, VA, is designed to simulate small unit battles (battalion-level engagements), with emphasis on unit movement, target acquisition, communications, weapon firing, and assessment of results. It is concerned with assessment of different weapons mixes, weapons effects, effects of tactics, and effects of sensors/detection devices on battle outcome.

2. DESCRIPTION

The model is a computerized, two-sided, Monte Carlo, combat simulation model involving land forces, armed helicopter, and recon aircraft. It is event-sequenced, with resolution to an individual soldier/vehicle. All real-world arty functions, i.e., FDC, FO/FIST and COPPERHEAD missions, are modeled with each firing unit belonging to a C^3 unit. Intelligence/information is passed to subordinate units, adjacent units, and higher echelon command units.

3. RBC CAPABILITIES

The model plays the effects of rain, fog/haze, snow/sleet, smoke, and dust, through the recently integrated NV&EOL detection model. The digitized terrain used by the model has elevations, concealment, and trafficability data. EW is not played; however, implicit representation of radar and communications jamming could be played with minimal reprogramming.

4. MODEL LIMITATIONS/RBC GAPS

Although an information-handoff process is represented in CARMONETTE through the use of delay times, there is no provision for communications jamming or any other EW effects simulation. The delay times due to communications jamming have not been quantified.

5. INPUTS AND SOURCES

INPUT	SOURCE
Probability of hit & dispersion	AMSAA
Probability of kill by round, target, range	AMSAA
Sensor data for acquisition	NV/EOL
Terrain data	WES
Neutralization weights for suppressive effects of ammo	User
Wpn and round characteristics	AMSAA

Vehicle mobility characteristics	WES and TACOM
Helicopter kill assessments	Falcon Research
Commo cycle times	User

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Aerosol	Non-existent
Smoke, dust, debris, fog/haze	Unvalidated
Rain/snow	Unvalidated
Terrain	

7. MODEL IMPROVEMENTS

With the integration of the NVL detection and NVL Smoke models, the next milestone will be the integration of the NVL Dust model.

CONTACT: Mr. Maceo Scott AV 258-4463/Ronald Reale AV 295-1639

AGENCY: TRASANA/Concepts Analysis Agency

STATUS: Operational

COMPUTER: UNIVAC 1108

LANGUAGE: FORTRAN V

COMBINED ARMS TACTICAL TRAINING SIMULATOR (CATTS) MODEL

1. PURPOSE

Designed to train battalion command groups in the command and control of combined arms operations against a thinking enemy in a free-play exercise using a variety of scenarios and terrain areas.

2. DESCRIPTION

The CATTS is a prototype, real-time, battalion-level, computer-driven battle simulator. It responds to friendly and enemy controller commands and fights (calculates) the battle at platoon company level. The model calculates line-of-sight, movement speeds, target acquisition, and weapons effects. It also considers environmental effects, smoke, illumination, suppression, obstacles, barriers, and ammo and fuel consumption rates. Outputs are presented in real-time, alphanumeric CRT reports which are used by company commanders to report their situation to the battalion command group. Digital map generation, remoted systems operations, and terrain data base reconfiguration are completed model improvements to the original system.

3. RBC CAPABILITIES

RED communications jamming is modeled explicitly, with RED and BLUE DF being modeled implicitly; implicit wind is assumed constant; terrain is modeled explicitly; CCM is unit SOP-dependent, i.e., radio silence; and ECCM pod to defeat AD, etc. Rain, fog/haze, cloud cover, night, light level, smoke, and dust are played explicitly.

4. MODEL LIMITATIONS

No radar jamming or chaff is represented in model. Model is limited to 100 units, where a unit can be any accumulation of personnel, equipment, ammunition and fuel. Limited to 50 obstacles, 20 minefields, 20 UGS and 100 control measures. Real-time requirement poses general limitations on the level of resolution at which battlefield aspects are represented.

5. INPUTS AND SOURCES

INPUT	SOURCE
Equipment characteristic deck	FMs
Ammo deck, sensor deck (Pd, sensitivity, etc.)	FMs, DARCOM, AMSAA
Unit Type characteristics deck	FMs
Weapons effects deck	TRADOC schools, AMSAA, JMEMs
Unit description deck	TO&E
Operational group deck	Internal

Suppression deck (curves)	CDEC
Terrain data base	DMA
Smoke visibility, data degradation	Internal logic

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Dust	Non-existent
Debris	Non-existent

7. MODEL IMPROVEMENTS

An electronic warfare module which includes direction finding and radar jamming is in design stage. Other improvements include LOS, perspective terrain views, and a logistics module.

CONTACT: LTC Frank McGurk AV 552-5485

AGENCY: CATRADA

STATUS: Operational

COMPUTER: Xerox Sigma 9

LANGUAGE: FORTRAN

8. COMMENTS/RECOMMENDATIONS

LTC Dickson: "There is a critical need for a standard manual of unclassified weapons effects approximations to be used by computer and manual training simulations; RED and BLUE Ph, Pk for direct-fire weapons; lethal areas for artillery and mortars are also needed." LTC Dickson provided the information contained in questionaire/synopsis but has since left CATRADA.

COMMUNICATION-ELECTRONICS ENVIRONMENTAL SIMULATION SYSTEM (CEESS) MODEL

1. PURPOSE

CEESS was developed to simulate the communication-electronics (C-E) environment of a deployed tactical force as a basis for electromagnetic compatibility/vulnerability (EMC/V) analysis.

2. DESCRIPTION

CEESS is a static model that represents the battle action at an instant in time. It simulates a C-E environment by extracting and manipulating information contained in data base files on equipments authorized to troop units, C-E netting structure, and equipment technical characteristics. Military units are task organized, Hqs established and the entire force model concept is represented for RED and BLUE forces down to company level. Communications nets, radar emissions, missile guidance and control links, beacons, EW schemes and other operations that affect the electromagnetic spectrum are established and simulated in the deployment.

3. RBC CAPABILITIES

Radar/communications jamming and DF capabilities are represented explicitly for both RED and BLUE in CEESS. Terrain, in the way of land form, vegetation and cultural features are played implicitly.

4. MODEL LIMITATIONS/RBC GAPS

Reactive jamming and other countermeasure tactics of the dynamic environment must be treated separately in analysis programs using CEESS output. Due to CEESS being a static model, it is limited in its ability to simulate changing processes such as troop movements, CCM, and spread spectrum communications systems. Also, a large amount of manual effort and data processing time are required. Process involves a lot of time for coordination among the TRADOC, PM, INTEL Community and Development Labs for agreement on proper scenario, TOE series, and threat environment. CEESS is not an analysis tool. It develops test beds which are used as input to other analytic models and programs.

5. EW DATA INPUT/REQUIREMENTS

(1) Equipment authorizations file

(2) Equipment characteristics file

(3) Equipment netting file

(4) Equipment applications file

(5) Antenna file

(6) Code file

CONTACT: Eugene Day AV 284-8515

AGENCY: Battlefield Electromagnetic Environment Office - TECOM, Alexandria, VA

STATUS: Operational

COMPUTER: IBM 370/165

LANGUAGE: COBOL/FORTRAN

CONCEPTS EVALUATION MODEL/THEATER FORCES EVALUATION BY COMBAT SIMULATION (CEM/TFECS) MODEL

1. PURPOSE

The CEM model was developed as a tool for measuring force effectiveness in terms of combat attrition at the FEBA, personnel, equipment, and materiel losses; and FEBA movement. The TFECS modifications to the CEM reflect the results of a methodology development effort for representing the effects of communications, intelligence operations, and EW on a theater combat force, primarily in terms of impact on the command estimation and decision process.

2. DESCRIPTION

CEM/TFECS is a two-sided, fully-automated, deterministic, theater-level combat simulation that incorporates the aggregated effects of C^3I/EW. CEM uses a continuous FEBA representation and simulates combat between BLUE brigades and RED divisions over 12-hour increments. The command decision process generates estimates of the situation and decisions at each of four C^2 echelons. Logistics operations, replacements, medical support, and air operations are treated as aggregated theater functions. The TFECS preprocessors generate rates of observation of battlefield activities by information collection systems, rates of attrition of these systems, probabilities of warnings of battlefield activities, probabilities of nets being jammed, and expected delays over communications means. The application of these factors, in combination with the actual number of sensors, jammers, and observables present in each Bde/Div combat section across the FEBA, determines the size and content of the report stream which feeds the automated division-and higher-level command estimation and decision process.

3. RBC CAPABILITIES

The TFECS methodology provides for representing the communications process, communications jamming, deception, ESM, collection of intelligence, and the attrition of these collection assets and jammers. The numbers and types of information-collection systems and jammers are set by the model user, as are the battlefield activities and entities, both real and deceptive. Individual equipment, messages or locations are not considered explicitly but as aggregate numbers in a given area (Bde/Div). The TFECS process computes the rate at which detection, interception, jamming or communications are occurring in the area.

4. MODEL LIMITATIONS/RBC GAPS

CEM/TFECS is a large-scale, low-resolution model with a high level of aggregation. The model utilizes expected values in the main, and results must be viewed in that light. A typical CEM application will require 25,000 data inputs, about 6 technical man-months, and 6 hours of dedicated computer time per 180 day theater run. TFECS will add significant additional burdens to already lengthy input data preparation and computer run time.

5. INPUT

The TFECS inputs are number of sensors, jammers, and communication nets; number of observable entities and report types; terrain masking factors; mean time to detect, confirm, and report by observable/sensor combination; mean times of observable exposure; number of communications systems states; damage factors for sensors; observable movement rate factors, probabilities of false detections, mean time to wait, switch means or abandon communications; equipment duty cycles, probability of loss, rejection, correct and incorrect acceptance of report; types and expected duration of battlefield warning events; maximum time of report usefulness; observable types associated with the unit activities at each echelon; mean and variance of strength estimates by enemy unit type and activity; equipment deployment delay times; and jammer target priorities.

6. REQUIREMENTS

Data requirements for CEM, although large and time consuming, have been developed in the past. Data for TFECS in terms of future information-collection resources, and jammer and communications systems, is best characterized as unvalidated since future system data is in the form of a ROC or O&O concept or nonexistent. There is currently insufficient data in the detail required for current systems performance parameters.

7. MODEL IMPROVEMENTS

Improvement plans will be formulated following test and evaluation of the new TFECS methodology.

CONTACT: Mr. Wallace Chandler AV 295-1686

AGENCY: Concepts Analysis Agency

STATUS: Developmental

COMPUTER: UNIVAC 1108

LANGUAGE: FORTRAN V

CLEW II MODEL

1. PURPOSE

To analyze the relative contributions of intelligence-collection and EW systems to combat operations for supporting balanced systems mixes and determining effectiveness levels.

2. DESCRIPTION

CLEW II is a force-on-force wargame that emphasizes individual combat and maneuvering and the influence of battlefield action and terrain on visual and electromagnetic signatures. It includes a functional level simulation of intelligence-collection systems, support processing, and C^3. It operates in an interactive mode to provide situation and intelligence reports on occurring events to "man-in-the-loop" commanders in support of maneuver and resource allocation decisions. CLEW II includes photographic and infrared systems such as the RF-4C, QUICK STRIKE Reconnaissance, and RPVs, and radar systems such as the UPD-4, MOHAWK SLAR, and SOTAS. The CLEW II model has been improved to include the incorporation of both airborne and ground-based tactical SIGINT systems. The improved version of the CLEW II model is now called ICOR. (See page B-74)

3. RBC CAPABILITIES

The model allows for explicit representation of communications jamming, radar jamming of target acquisition/intelligence-collection systems, as well as explicit treatment of DF, rain, fog/haze, cloud cover, night, and smoke. Terrain, in the way of land form, vegetation, and cultural features, is modeled explicitly.

4. MODEL LIMITATIONS/RBC GAPS

"Man-in-the-loop" dependencies, such as human judgement, learning curves, and player-to-player variations, are considered model limitations.

5. INPUTS AND SOURCES

INPUT	SOURCE
Terrain data	Maps
Weapons parameters	TETAM tests, internal battle book, open literature
Intel/EW parameters	OTs/DTs/ROCs
Unit initial positions/equipment	SCORES, etc.

6. REQUIREMENTS

The following were identified as requirements. Answer to "What is the 'disruptive' impact of targeting command posts (counter C^3 by firepower) and

interdiction (by air, indirect-fire, barrier, etc.) of second echelon maneuver elements?" More commonly accepted lethality and attrition data for air support (close air, interdiction, attack helicopters, etc.). Improved input/output routines to expedite interactive turn-around, allowing greater numbers of excursions or replications to be made.

7. MODEL IMPROVEMENTS

(See ICOR)

CONTACT: Mr. Louis W. Schlipper (703) 821-5131

AGENCY: The BDM CORP, 7915 Jones Branch Drive, McLean VA 22102

STATUS: Operational at BDM

COMPUTER: CDC 6600 or 176 (Interactive I/O, CDC 6600, 7600 or 176 batch mode.

LANGUAGE: FORTRAN IV

COMMUNICATIONS-ELECTRONICS II.5 MODEL (COMMEL II.5) MODEL

1. PURPOSE

To assess the impact of proposed communications-electronics (C-E) concepts within a dynamic, ground combat environment.

2. DESCRIPTION

COMMEL II.5 is a fully-computerized, dynamic, two-sided, free-running model that depicts ground combat between two divisional forces with resolution to company level. The model is a tool which allows observation of communications in a combat environment and provides a means for the determination of relative superiority of competing communications systems concepts. COMMEL II.5 offers a "realistic" representation of the operational capabilities of given communications systems, in that systems are subject to realistic conditions (e.g., destruction and jamming.) The model is free-running in that it proceeds from action initiation to conclusion without intervention.

3. RBC CAPABILITIES

The ECM feature of the model allows jamming of single-channel radio nets. Based on the assessed effectiveness of jamming (determined in advance by off-line analysis), the model randomly selects the appropriate number and types of links to be jammed. Each selected link is jammed for 15 simulated minutes. The ESM system features are represented by a DF intelligence event chain. The chain begins with sensor acquisition of DF information and ends with the formation of artillery target lists incorporating the new intelligence.

4. MODEL LIMITATIONS/RBC GAPS

Currently, COMMEL II.5 does not simulate air traffic control, air defense, tactical air or airmobile operations. Also, no provisions exist for explicit play of special weapons, amphibious operations, guerrilla or counterguerrilla warfare, or other specialized military activities. It cannot be used to compare tactics, weapon systems, logistics policies, or measure logistic requirements. Also, computer limitations restrict communications/EW simulations to one-way analysis, i.e., simulation selected communications for one force with the opposing force having simulated rudimentary EW.

5. INPUTS AND SOURCES

INPUT	SOURCE
Terrain of the battle area, organization of the forces on each side, force deployment, force strengths, force rates of movement, weapon ranges, weapon effectiveness, weapon vulnerabilities, decision parameters, communications system or	Determined by user.

concepts, message-generation parameters, ECM/ESM data (jamming/DF), and communications ECCM characteristics.

6. MODEL IMPROVEMENTS

The COMMEL II.5 model has been expanded to allow 2000 explicit C^2 links, variable jamming levels over time, expanded DF system capability, and direct intelligence enhancement of artillery targeting routines. This expansion still permits only one-sided EW/communications analyses due to model size and computer limitations.

CONTACT: Mr. John Clark AV 295-1609

AGENCY: Concepts Analysis Agency

STATUS: Operational

COMPUTER: UNIVAC 1108

LANGUAGE: FORTRAN IV

COMO III MODEL

1. PURPOSE

COMO (Computer Model) III is a critical event, time-sequenced, general purpose, Monte Carlo, combat simulation model, originally developed by SHAPE Technical Centre (Hague, Netherlands) to analyze Short-Range Air Defense (SHORAD) engagements. The most extensive use of COMO has been in the evaluation of air defense systems and deployments.

2. DESCRIPTION

The COMO model consists of a frame which structures and manages the critical-event simulation to which weapon system decks are attached and integrated. These weapon decks, which can represent air defense systems, airbases, aircraft, missiles, bombs, and ground targets (both friendly and hostile), are written in FORTRAN code to describe the weapon system functional operation to the particular levels of resolution required for the specific analyses. By use of the Computer Run Assembly Program (CRAP), these weapon decks are integrated into the frame with a specific executable model, results from which will be used to evaluate specific weapon system conditions. The inputs for a specific COMO computer simulation are called COMIL (COMO Input Language). These inputs describe the scenario to include system locations, general system movements, performance and physical characteristics, and the necessary information to insure interaction between friendly and hostile systems. The outputs of a specific computer simulation in COMO can be analyzed to determine the exact cause and effect relationships between weapon systems, making possible the analysis of synergistic effects.

3. RBC CAPABILITIES

Weapon decks that utilize radar acquisition/detection are modeled to include effects of electronic warfare and countermeasures by means of the radar range equation. Further, in-depth analysis of deceptive jammers can be accomplished at the engineering model level of COMO. This application significantly increases the computer time required for the analysis. As the need to reflect detail in the environment increases, computer run times of large-scale simulations approach several hours on a CDC7600. The effects of chaff, deceptive jamming, electromagnetic attentuation, and weather are best analyzed off-line with more detailed COMO weapon decks and handled as degraded input parameters in large-scale simulations. The COMO model will be able to incorporate any RBC provided that sufficient detail is known to adequately model its effects.

4. MODEL LIMITATIONS/RBC GAPS

Current COMO weapon decks do not explicitly incorporate such RBCs as weather, chaff, communication links and delays, battlefield movement, and nuclear/biological/chemical effects. MICOM is currently upgrading, at the engineering COMO model level, the PATRIOT weapon deck to determine the effect of communication links and time delays. SHAPE Technical Centre is currently upgrading their COMO capability to include command and control between Air Force and Army elements.

5. INPUTS AND SOURCES

INPUT	SOURCE
Scenario	TRASANA, USAADS, CAA
BLUE system characteristics	MICOM (DRSMI-DS) for Air Defense Systems USAF for BLUE Air Interceptor Systems
RED system characteristics	HQ DA (ACSI), INSCOM
Terrain	TRASANA, USAADS Data Bases

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Aerosols, smoke, dust, debris, fog/haze, rain, snow	Must define environment conditions sufficiently to establish effects on each particular system characteristic.
Chaff, deceptive ECM	Data must be evaluated to determine the appropriate factors to include in the radar range equation or to include the effects of chaff and deceptive ECM into appropriate system characteristics.
Nuclear	The effects of a nuclear environment must be determined, in particular the effects on reliability, lethality, and signal-to-noise radar range calculations.
Chemical/biological	The effects of chemical and biological operations (i.e., operating in a protective suit, etc.) to determine the effect on system operations.

7. MODEL IMPROVEMENTS

The MICOM weapon system project managers are continually upgrading their weapon decks to insure that their systems are adequately represented in the COMO model. This upgrade includes, additionally, the review of system input data in the COMIL format.

CONTACT:	TRASANA	Mr. Bob Wiley AV 258-4333
	USAADS	Mr. Peter Olson AV 978-7500
	MICOM	Mr. Charles Colvin AV 746-4972
	CAA	Dr. John Dockery AV 295-0553

STATUS: Operational - Active/Undergoing augmentation

COMPUTER:	TRASANA	UNIVAC
	USAADS/MICOM/CAA	CDC
LANGUAGE:	UNIVAC FORTRAN V	
	CDC FORTRAN IV/COMPASS	

8. COMMENTS/RECOMMENDATIONS

The model is used extensively in West Germany and Holland. US users include MICOM, CAA, TRASANA, USAADS, NWC, SANDIA, IDA and Sperry Corporation. The versions at MICOM, TRASANA, and USAADS are quite similar and will be baselined by MICOM in the near future. Due to its widespread acceptance/use, and versatility (since it can handle one-on-one as well as a theater-level war by the addition of the required weapons decks), this model may be the one to develop to full potential. It handles EW explicitly and with good detail. Chaff could be played explicitly if data were available and in the right form. Model should consider IFF and C^2. It should be noted that the German version of COMO is currently undergoing a modification by SDC to incorporate the C^2 capability.

COMWTH II MODEL

1. PURPOSE

COMWTH II was developed to quantify the "military worth" of camouflage, and is currently being used to develop camouflage development goals and objectives and to support the Theater Nuclear Force Survivability (TNFS) Program.

2. MODEL DESCRIPTION

COMWTH II is a computerized, deterministic, one-sided simulation of the major battlefield factors affecting target detection, evaluation and the engagement process. Specific battlefield functions included in COMWTH II are:

a. The ability of sensors to detect elements of a friendly force.

b. The ability of the enemy to accurately identify detected friendly elements.

c. The ability of the enemy to locate detected friendly elements and define target size.

d. The ability of hostile weaponry to engage detected friendly targets during stay time at identified location.

e. The effectiveness of enemy fire on friendly force systems is not explicitly modeled in detail but is represented implicitly by performance characteristics entered through the input data stream. The following generic categories can be represented:

- Target acquisition systems (RED)
- Intelligence-gathering systems (RED)
- Communications systems - delay time (RED)
- Weapons systems - surface-to-surface and air-to-surface

3. RBC CAPABILITIES AND MODEL LIMITATIONS

COMWTH is an implicit model relying upon input information to represent sensor performance, environmental effects and operational interactions. Thus, the interactions between sensors (radars), communications, command and control, intelligence and various EW factors must be represented in the implicit, aggregate manner for consideration by COMWTH; given these, associations can be developed. COMWTH represents a technique for studying the influence of any RED SIGINT/EW resource on friendly forces. It accounts for the implicit representation of EW, weather, obscurants and terrain.

4. INPUT REQUIREMENTS

The following describes some of the kinds of input data used by COMWTH:

SENSOR INFORMATION	COMMENTS
Sensor description	Alphanumeric description of sensor type (maximum of 15 types)
Sensor pattern	1) Circular 2) rectangular 3) moving (immediate response) 4) moving (delayed response).
Sensor location (initial)	Any convenient rectangular coordinate system may be used
Sensor location (final)	This input necessary only for moving sensors
Arrival time	Time at which the sensor arrives at the initial location
Departure time	Time at which the sensor a) departs the initial location for stationary sensors, b) departs the final location for moving sensors
Processing time	Elapsed time after detection until sensor reports detection information
Sensor maximum range	Measured in length as appropriate for the sensor pattern
Sensor field of view	Indicates maximum width of sensor pattern a) Measured in radians for circular pattern b) Measured in length for rectangular pattern c) Not applicable for moving sensors
Height above surrounding Terrain	Used to determine probability of line-of-sight from sensor to target.
Element probability of detection	Pd versus range is indicated for each sensor type against each element type and each decoy type, during day and night in three environments.
Sensor target location error	Target locating error expressed as a circular error probable described by its radius. Input in as a matrix for each sensor type versus range.
Countermeasures effectiveness	Matrix of values for each sensor type, against each element type, day or night, in three environments.
Unit description	Alphanumeric description of target unit type (Maximum of 15 types)

Target radius	Radial dimension of circular area target with uniform random distribution of elements.
Element type composition	The target may contain up to 4 element types selected from a list of 11 types. The quantity of each type is also indicated.
Physical target location on battlefield	Any convenient rectangular coordinate system may be used to locate target center.
Target arrival and departure times	The time at which the target arrives and departs the designated location.
Rate of detectable activity	Indicated as activities per hour.
Decoy type composition	The target may also contain up to 4 decoy types, selected from the same list of 11 types. The quantity of type is also indicated.

CONTACT: Dr. Ken Oscar AV 354-2654

AGENCY: Camouflage Laboratory, MERADCOM

STATUS: COMWTH II is operational

COMPUTER: CDC 6600 or comparable machine

LANGUANGE: FORTRAN IV

5. COMMENTS

As part of the TNFS effort, percent of knowledge tables for RED target acquisition on BLUE for theater nuclear force target acquisition is in progress. A limited analyst manual is available for COMWTH II; no user manual is presently available.

DETAILED EW/ECCM ANALYSIS MODELS

1. BACKGROUND AND PURPOSE

The Electromagnetic Vulnerability and ECCM Division, Electronic Warfare Laboratory, Ft Monmouth, is responsible for conducting EW vulnerability assessments on US Army communications-electronic (C-E) equipments/systems (except guided missiles). In conducting EW vulnerability assessments and evaluating ECCM techniques, many "submodels" are used within an overall evaluation methodology. Most of these "submodels" are manual and engineering in nature, and are tailored to address specific issues in each assessment. The models are used to ensure that C-E hardware design and system architecture are optimized for operation and survival in a hostile EW environment.

2. DESCRIPTION

The "submodels" provide a variety of outputs needed to support EW vulnerability assessments and formulation of ECCM requirements. The outputs include J/S contours; a time history of AJ (antijam) margin required over the duration of an event/mission time period, situation, etc.; DF bearing and fix location errors; intercept range, propagation losses, digitized terrain data, receiver J/S thresholds, and threat mission time lines. The models have been utilized to evaluate the EW vulnerability of the following systems:

o Target Acquisition systems

AN/TPQ-36 Mortar Locator
AN/TPQ-37 Artillery Locator
Marine Corps Hostile Weapons Locations Systems
Remotely Piloted Vehicle (RPV)
Integrated Communications Navigation Systems (ICNS)

o Intelligence gathering systems

AN/UPD-2 SLAR data link
QUICK LOOK Data Link
REMBASS Data Link

o Command and control systems-TACFIRE

o Communications systems

SINCGARS-V
Existing VHF/UHF Radios
MALLARD I

o Weapon systems

XM1 Tank Communications
Advanced Attack Helicopter
UTTAS
PERSHING C^3
PATRIOT C^3

o Navigation/Positioning systems

LORAN-D
Doppler Navigator (AN/ASN-128)
Tactical Landing System (TLS)
Microwave Landing System (MLS)
Radar Altimeter (AN/APN-209)
IFF

The models are being utilized (or will be utilized in the near future) to evaluate EW vulnerability for the following systems:

o Target Acquisition systems

Battlefield Surveillance Target
Acquisition Radar Systems (BSTAR)

o Intelligence gathering systems

Standoff Target Acquisition Systems (SOTAS)
ICNS/SOTAS
Modular Integrated Communications Navigation System (MICNS)
Night Vision Devices

o Command and Control systems

Command Posts (Corps and below)
Tactical Operation System (TOS)
Air Defense C^3
Intelligence Surveillance and Target Acquisition (ISTA) C^3

o Communications systems

SINCGARS-V
Army Data Distribution System (ADDS) Mark I
ADDS Mark II
Joint Tactical Information Distribution System (JTIDS)

o Class II and III terminals

Packet Radio
Multiple Subscriber Equipment (MSE)
Satellite Communications

o Weapons systems

Advanced Scout Helicopter (ASH)
Nuclear capable units

- o Navigation/Positioning systems

  Position Location Reporting System (PLRS)

3. RBC CAPABILITIES

In constructing detailed models of electronic equipment operating in an EW environment, the following illustrates how the influences of various aspects of EW are described:

o Commo jamming - link failure, system degradation, message delay, mission success, etc.

o Radar jamming - target definition, system degradation, information delay, mission success, etc.

o DF'ing - survivability and ability to accomplish mission in face of hostile electronic order of battle (EOB) data base.

Various types of jamming are considered, to include:

o Brute force - CW, spot CW, swept CW, swept noise, noise, and barrage.

o Intelligent - repeater, follower, and adaptive.

o Deception - spoofing, meaconing, and imitative electronic deception.

Further, in looking at jamming threats, jammer mission priorities and multiple jamming sources are considered.

4. LIMITATIONS OF MODELS

The models of systems in various EW environments are not dynamic -- only snapshots of situations are available.

5. INPUT REQUIREMENTS

During early phases of equipment/systems development, inputs are limited to data from theoretical calculations. As the equipment/system proceeds through the development cycle, laboratory and field data are used to refine the model data base and validate critical subroutines in the model.

6. MODEL IMPROVEMENTS AND DEVELOPMENTS IN-PROCESS

Work is ongoing to:

o Update current in-house capabilities to use the TRASANA BATTLE scenario.

o Develop "EW kill" and Electronic Warfare Support Measures (ESM) models for target acquisition to support the Army's Theater Nuclear Force Survivability (TNF/S) study.

o Develop models to evaluate the EW vulnerability of C^3 systems.

o Develop a model to determine the terrain profile between any two selected points in Europe, on a curved earth.

CONTACT: Mr. Bruce Miller AV 995-4358

AGENCY: Electronic Warfare Laboratory, Electronics Research and Development Command, Ft Monmouth, NJ

COMPUTER: Depending on specific model, programs are written for HP 9830, Burroughs B5700 or Interdata 8/32.

LANGUAGES: BASIC or FORTRAN

DIVISIONAL ELECTRONIC WARFARE COMBAT MODEL (DEWCOM) MODEL

1. PURPOSE

The model will be used to evaluate alternate communications and electronic warfare concepts in terms of their impact on combat.

2. DESCRIPTION

The DEWCOM Model is a two-sided, stochastic, combat simulation which focuses upon tactical communications, electromagnetic intelligence and target acquisition systems, and the electronic warfare directed against those systems. Two independent, variable forces are modeled in a conventional tactical engagement. Each force consists of realistically-deployed maneuver units, communications units, artillery units, and support units. As combat is simulated between the forces, communications are generated which must be transmitted over simulated links. Successful communication is necessary for units to take desired actions. The communications may be intercepted or located by the opposing side and result in appropriate tactical actions.

3. RBC CAPABILITIES

The model portrays two-sided communications, radars, and electronic warfare explicitly. The simulation of electronic warfare includes spot and barrage jamming, direction finding, and interception of transmissions. Response to the content of messages can be played for a small number of message types. EW operations can take place on both ground-based and airborne platforms. Expendable jammers can also be accommodated. Environmental factors such as weather and dirty battlefield conditions can be portrayed implicitly by degrading the performance characteristics of radios, radars, etc., and reducing unit movement rates, set-up times and other factors, as appropriate. The modified performance characteristics can be introduced at a predetermined time in the course of the simulation.

4. MODEL LIMITATIONS/RBC GAPS

Deception cannot be portrayed in the model. No specific provisions exist for representing electro-optical sensors/detectors.

5. INPUTS AND SOURCES

INPUT	SOURCE
Terrain	TBD
Equipment	
TOE	
Order of Battle	
Communication organization	
orders (doctrine)	

6. REQUIREMENTS

TBD

7. MODEL IMPROVEMENTS: Model just developed, improvement not identified.

CONTACT: Mr. Martin Dwarkin AV 295-1645

AGENCY: Concepts Analysis Agency

STATUS: Operational

COMPUTER: UNIVAC 1108

LANGUAGE: SIMSCRIPT II.5

8. COMMENTS

Model and documentation have been delivered, and model is presently undergoing testing. Anticipated completion date for testing is February, 1981.

DIRECTION FINDING (DF) MODEL

1. PURPOSE

DF was developed by Georgia Tech University in 1978 and completely revised by TRASANA during 1QF79. It is an engineering model whose purpose was to support the assessment of the DF vulnerability of radio equipment. DF can also be used to assess the performance of various SIGINT systems against a fixed emitter (target) array.

2. DESCRIPTION

DF is a one-sided, deterministic model that computes the vulnerability of radar and radio transmitters to DF. Model inputs are the target emitter and DF system parameters and deployment. Outputs are probability of intercept, probability of DF, elliptical error probable (EEP), and circular error probable (CEP) for each target emitter.

3. RBC CAPABILITIES

DF can determine the probability of locating any type of emitter; radar, commo or a jammer. Since model is one-sided it can play RED as well as BLUE, if RED DF system characteristics are available.

4. MODEL LIMITATIONS/RBC GAPS

DF assumes perfect direction-finding network without manual plotting problems or intercommunication problems.

5. INPUTS AND SOURCES

INPUT	SOURCE
DF sys parameters, i.e., rcvr gain, noise figure, req'd output as S/N, DF pos, accuracy/location, emitter freq, output ant. gain, loc., noise levels.	US Systems, FMs, TM, Test reports, DARCOM, PMs RED Sys - OACSI, NSA, DIA, CIA, FSTC
Environment factors, terrain, season of the year.	DMA (Mapping), ATLAS sources
TRASANA engineering estimates	TRASANA

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
RED DF systems paramenters	Non-existent, insufficient quantity, and unvalidated

7. MODEL IMPROVEMENTS

None in planning stage. Normally, modifications/improvements are generated by specific study requirements.

CONTACT: Mr. Bob Bennett AV 258-5208

AGENCY: TRASANA

STATUS: Operational

COMPUTER: UNIVAC 1108

LANGUAGE: FORTRAN V

DIVISION AIR DEFENSE (DIVAD) GUN SIMULATION MODEL

1. PURPOSE

To provide data that will assist the DIVAD Gun Source Selection Evaluation Board in selection of the single contractor for production award.

2. DESCRIPTION

The DIVAD Gun Simulation Model is a Monte Carlo model that simulates the complete DIVAD gun system's operation against a given threat input profile. The following submodels constitute the program: Target Flight Profile, Search/Acquisition Radar, IFF, Radar Track, On-Board Computer, Gun, and Effectiveness submodel. The model simulates a one-on-one engagement of the DIVAD gun vs. a passive target.

3. RBC CAPABILITIES

The following EW environments are played implicitly: RED radar jamming, RED chaff deployment, all weather, and all obscurants and vegetation.

4. INPUT

Target flight profile, table of Pd vs tgt range w/varying weather, track radar measurement errors, optics/laser tracking errors, subsystem response rates, bullet ballistics, Kalman filter parameters, gun servo response/pointing errors, proximity fuze burst point distributions, target component vulnerable areas, and firing doctrine.

5. REQUIREMENTS

Model(s) in debug stage - requirement not determined.

6. MODEL IMPROVEMENTS

See paragraph 5, above.

CONTACT: George Gaydos AV 880-6556/5505

AGENCY: PM DIVAD GUN, ARRADCOM, Dover, NJ

STATUS: Debug Stage, operational - Jan 81

COMPUTER: CDC Cyber

LANGUAGE: FORTRAN IV

DIVLEV MODEL

1. PURPOSE

DIVLEV is the Army Materiel Systems Analysis Activity's division level wargame. It is used to study the battlefield environment, effectiveness of Army systems (weapons, sensors, and vehicles), and to produce detailed time dependent scenarios that can be used as input to higher resolution models of specific Army systems.

2. DESCRIPTION

DIVLEV is a player-controlled, computer-assisted, two-sided wargame. The computer is used for bookkeeping, calculation of weapons effects/attrition assessment and implementation of player orders. DIVLEV is able to consider forces consisting of several divisions each. The force structure described by kind of units, composition of units, command structure, deployment of units, is flexible and is easily initialized and changed by the players. DIVLEV is able to play the following kinds of units: maneuver units (direct-fire weapons) at battalion or company level, artillery battalions or batteries, individual sensors (except for the visual target acquisition associated with direct fire weapons), supply areas, helicopter (gunships), close air support, and SSM and SAM batteries.

3. RBC CAPABILITIES

a. DIVLEV is presently able to explicitly represent reduced visual performance due to: terrain and vegetation restrictions on line-of-sight; obscuration by fog, smoke and dust; and illumination conditions (day/night). DIVLEV is able to explicitly represent variations in mobility due to terrain and vegetation, and to other natural and man-made obstacles such as rivers, built-up areas, and mine fields.

b. A model to explicitly account for the effects of various elements of electronic warfare (EW) is presently being designed for incorporation with DIVLEV. The EW model and associated combat model will enable the quantification of the effects of jamming, direction finding (df'ing), and anti-radiation missiles in terms of measures of effectiveness pertaining to the situations of armies in the field.

c. The EW model being designed will support an EW game. EW resources will be given to both sides and each side will control the deployment and allocation of their EW equipment as well as those resources that represent EW targets; e.g., radios and radars.

d. The EW, allied radar, command, control and communications models are being designed for interaction with the basic movement and attrition programs of DIVLEV. It is planned that command posts and EW resources (jammers, d.f. sites) can be "units" whose movement and operation can be specified by the players. Further, these command and EW resources will be susceptible to being located, targetted and attrited.

4. RBC GAPS AND MODEL LIMITATIONS

a. In order to determine the effects of EW, a representation of the command and control (C^2) process must be part of the model. DIVLEV does not presently play C^2 at various echelons; rather DIVLEV requires players to input plans that indicate the action an individual unit should take upon realizing a specific situation. The realization of a given situation is obtained from ground truth without any delay in time or variation in information accuracy.

b. To implement the EW model in DIVLEV, the C^2 process associated with artillery fire control is slated for modeling; other C^2 processes associated with unit operations and intelligence will be modelled subsequent to the artillery fire control C^2.

5. REQUIREMENTS

Item level performance data needs:

a. Radio

(1) How intelligibility varies as a function of signal/noise ratio and kind of noise (jam) signal.

(2) The power output of the radio.

(3) Antenna gain.

(4) Set-up and march order time.

b. Radar

(1) How the range performance (probability of detection, acquisition) varies as a function of jam power at radar antenna and kind of jam signal.

(2) How the range performance (probability of detection, acquisition) varies as a function of chaff type, chaff density, and chaff position in target-radar geometry.

(3) Set-up and march order times.

c. Intercept/Direction Finding Systems

(1) Antenna gain

(2) Sensitivity.

(3) Probability of detecting, recognizing and identifying radio and/or radar transmissions as a function of radio/radar "on time," density of radio/radar signals within band of interest.

(4) Time to perform line-of-bearing measurements and time-of-arrival measurements and correlate individual station/position measurements to make emitter-position determination.

(5) Set-up and march order times.

d. Jammers

(1) Kind of jam signal

(2) Power.

(3) Antenna gain.

(4) Set-up and march order times.

e. ARM/ARP

(1) Probability of hit given a launch as a function of radar, decoy/blinking mode, and launch pt-to-target range.

Operational data needs (player input):

a. Radios

Antenna position and height.

b. Radio - Networks

(1) Members.

(2) Frequency used.

(3) Messages, message routing, alternate routes.

(4) Time required to change frequency.

c. Radar

(1) Frequency used.

(2) Antenna position and height.

(3) ECCM employed.

d. Intercept and Direction Finding Systems

(1) Allocation: area of interest (frequencies) - priorities.

(2) Antenna position and height.

e. Jammers

(1) Allocation: area of interest (frequencies) - priorities.

(2) Jam mode: spot, barrage.

(3) Antenna position and height.

f. ARM

Target allocation

g. Command and Control

Allocation of resources - how EW equipment, sensors, weapons, and units are allocated in real-time.

Environmental data needs -

Background radio and radar traffic.

CONTACT: Paul Kunselman AV 283-2417

AGENCY: US Army Materiel Systems Analysis Activity, Aberdeen Proving Ground, MD

STATUS: Operational. EW model scheduled for completion in June 1981.

COMPUTER: CDC 7600

LANGUAGE: FORTRAN IV

COMMENTS: Documentation on DIVLEV is available.

DUNN-KEMPF (D-K) MODEL

1. PURPOSE

D-K is a company-level, manual, battle simulation, designed to train company commanders and platoon leaders in (a) US and Soviet small unit combined arms tactics, (b) weapons systems capabilities and employment techniques (c) techniques of fire, (d) battlefield observation, (e) employment of indirect fires and CAS, (f) use of helicopters, (g) suppression (h) obstacles and fortifications, (i) use of smoke, (j) commo in an EW environment, and (k) proper use of terrain.

2. DESCRIPTION

D-K is a two-sided, manual, wargame played on a 3-D terrain board using miniatures to represent individual vehicles and dismounted units. A complete exercise will represent approximately 15 minutes of actual combat. A turn is a 30-second slice of the battle taking 5 - 10 minutes real time to complete. Sequence is indirect fire, direct fire, movement. Combat results are determined stochastically using two dice and a combat results table. A bound is when both sides have had a turn at the battle sequence during the 30-second slice.

3. RBC CAPABILITIES

Commo jamming is based on a die roll where players are precluded from FM radio commo for four bounds. Model also plays wind, arty-delivered smoke, and terrain; wind direction is randomly selected, for duration of game. Smoke, played by units with indirect fire capability, is used to preclude observation and is represented by cotton balls on the terrain board. Terrain is represented explicitly by use of terrain board.

4. MODEL LIMITATIONS/RBC GAPS

Simulation of light infantry actions is not as precise as that of tank engagements. Weapon firings are not time-sequenced, therefore some errors in combat results occur. Radar jamming, DF'ing, chaff, and ARMs are not considered. A revised rule book which will allow explicit play of two electronic counter-countermeasures, i.e., switching to an alternate frequency and changing the antenna direction is currently being tested.

5. INPUTS AND SOURCES

INPUT	SOURCE
Rules of play, P_k tables	"Battle Guide to Simulation"
Arty effects P_k, P_h, P_s	TRADOC pamphlets, field manual, JMEMs

Direct fire P_k, P_h	Field manuals, JMEMs
CAS effects P_s, P_h, P_j	"
Smoke characteristics	TRADOC, Smoke PM

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Prob of detection under all RBCs	Insufficient quantity
Dust data	Non-existent
Fog/Haze data	Poor quality

7. MODEL IMPROVEMENTS

Add supplements to provide improved capability in area of light infantry, airborne, and airmobile. The use of frequency hopping will be available as a CCM whenever jamming occurs. Use of a 3-D template to better portray time sequencing of smoke.

CONTACT: MAJ Doug Nolen AV 552-3395/3180

AGENCY: CATRADA

STATUS: Operational

COMPUTER: None

LANGUAGE: N/A

ECMFUZ MODEL

1. PURPOSE/DESCRIPTION/RBC CAPABILITIES

ECMFUZ is a computer model that simulates the PATRIOT missile's fuze during an engagement with an air target containing a fuze jammer. A variety of fuze jamming, as well as multiple jamming sources, can be accounted for in the model.

2. MODEL LIMITATIONS/RBC GAPS

None identified.

3. EW DATA INPUT/REQUIREMENTS

INPUT	SOURCES
o Engagement coordinates of PATRIOT missile and target aircraft in a target-centered reference frame.	o Engagement dynamics are typically provided by PATRIOT hybrid engagement simulation.
o Relative speed and directional cosines of PATRIOT missile.	
o Total fuze jammer power and blink frequency	o Fuze jammer power is obtained from PATRIOT threat.

4. MODEL IMPROVEMENTS

Validation of computer simulation of the fuze and fuze-jammer coupling is presently underway using field measurement data.

CONTACT: Dr. J. E. Seltzer AV 290-3140

AGENCY: Harry Diamond Laboratories

STATUS: ECMFUZ is operational

COMPUTER: PRIME (mini)

LANGUAGE: FORTRAN IV

5. COMMENT

Documentation on ECMFUZ is in the process of being prepared.

AD-A091 317 ARMY TRADOC SYSTEMS ANALYSIS ACTIVITY WHITE SANDS MIS--ETC F/G 17/4

ELECTRONIC WARFARE IN ARMY MODELS - A SURVEY.(U)

AUG 80 H P BUSTILLOS, P KUNSELMAN, J B CLARK

UNCLASSIFIED TRASANA-TR-7-79 NL

2 OF 3

AD A091317

ENVIRONMENTAL INTERFERENCE EFFECTS MODEL (EIEM) MODEL

1. PURPOSE

EIEM is used to assess the operation of communication-electronics (C-E) equipment in electromagnetic environments that are associated with given tactical situations.

2. DESCRIPTION

a. EIEM is the primary element of a library of computer models. EIEM, in conjunction with the other models in the library, is able to estimate a wide variety of C-E equipment performance measures. Some examples are: probability of communications, probability of location via direction finding, probability of jamming, and probability of intercept.

b. A C-E system is evaluated by determining the electromagnetic environment of desired and undesired signals at the receiver antenna. The signal type, relative frequency, duty cycle, and distribution of the received power (propagation path loss and antenna gains are the main determinants of received power) associated with each emitter, are considered in characterizing the electromagnetic environment. Empirically derived receiver degradation data are then used to represent the receiver's performance in the electromagnetic environment described above.

c. To characterize the EM environment, the EIEM model is able to consider C-E equipment of both friendly and opposing forces, together with the doctrine and operational procedures governing the use of the C-E equipment.

3. RBC CAPABILITIES

EIEM considers the following environmental parameters associated with EW: communications and radar jamming, and communications and radar DF'ing. In addition, various forms of precipitation, obscurants, and terrain features such as land form, vegetation and cultural detail are considered in determining propagation losses.

4. MODEL LIMITATIONS/RBC GAPS

a. EIEM is not able to model time-dependent system characteristics/processes, such as loading and alternate route determination used in automated switching and routing systems.

b. EIEM does not have the capability to treat chaff, however, current plans include the development of a chaff model.

c. EIEM requires a CDC 6000, 7000 or Cyber Series computer with at least 160K (octal) central memory, two large disk packs and two tape drives.

5. INPUTS AND SOURCES

INPUT	SOURCES
o A deployment of C-E systems consistent with the tactical situation under study.	o Generally the C-E systems deployment is provided by the C-E Systems Division of the US Army Communications R&D Command (CORADCOM)
o Equipment data files containing: antenna gains and patterns, receiver scoring data (reflecting probability of correct operation as a function of signal-to-interference or signal-to-jammer ratios and frequency)	o All equipment characteristics are obtained from laboratory testing when possible, from field tests as a second choice, or from analytical means when hardware is not available.
o Military data files containing network traffic and duty cycle data; these data are matched to the deployment records according to unit and operator functions and deployment posture.	

6. MODEL IMPROVEMENTS

EIEM is being modified to include the cabability to evaluate electro-optical equipments in the same manner as that for radio frequency equipment.

CONTACT: Mr. T. Flahie AV 879-2365

AGENCY: US Army Electronic Proving Ground, Ft Huachuca, AZ

STATUS: EIEM is operational

COMPUTER: CDC 6000, 7000, or Cyber Series with NOS/BE operating system

LANGUAGE: CDC Extended Fortran and assembler language

7. COMMENTS

EIEM is documented in three volumes: Management Aspects, Theory, and Computer Program Descriptions.

ELECTRO-OPTICAL CM SIMULATION FACILITY (EOCM SIM FAC) MODEL

1. PURPOSE

To evaluate the effects of EOCM on missile hardware with emphasis on air defense systems. The purpose of the facility is to simulate the flight of a missile using an electro-optical seeker in a CM environment.

2. DESCRIPTION

a. The EOCM facility has existed since 1972. To date, all work has been on AD missile systems operating in the IR portion of the electromagnetic spectrum. During the past six years improvements have been made to add greater sophistication in modeling and EW investigation capabilities. Current plans call for adding an Ultraviolet-Infrared Scene Generator to extend the capability to investigate ECM environments over a broader EM spectrum. EOCM which can be evaluated include confusion (modulated EO) jammers, decoys (flares), and suppression of target signatures.

b. The primary output from the simulations is miss distance, which provides criteria from which the overall effectiveness of a CM technique may be determined. Analysis of additional outputs such as target and missile trajectories, missile signals; events such as target maneuver onset and jammer programs, missile firing doctrine variations, etc., aid in the determination of CM technique effectiveness. This is a " hardware-in-the-loop", dynamic, laboratory flight simulation. The major asset of the facility is the dynamic IRCM simulator, a tool which permits IRCM investigations using semi-physical, closed-loop, dynamic, laboratory flight simulation. It consists of a missile flight simulator (MFS) and a hybrid computer.

3. RBC CAPABILITIES

RBC includes RED and BLUE explicit radar jamming, RED and BLUE explicit EO jamming. Fog/Haze and sleet/snow are played implicitly. All obscurants are handled explicitly as well as land form. Both electro-optical and radio-frequency jamming are considered. The nature of the jamming, including time of onset, depends upon the investigation/evaluation being performed. Both threat specific and generic jamming are investigated. In general, single jamming sources are used; however, the facility has the capability of considering multiple jamming sources.

4. MODEL LIMITATIONS/RBC GAPS - CONFIDENTIAL

5. DATA INPUTS/REQUIREMENTS

Data inputs include missile system aerodynamics, wind tunnel reduced data or aerodynamic models, aircraft and EOCM radiation signatures, aircraft performance characteristics and missile firing doctrine. Missile optics/detector/gyro characteristics are required for electronic breadboard simulations.

Data are CONFIDENTIAL.

6. MODEL IMPROVEMENTS

Extension of simulator into the ultraviolet region

CONTACT: Gary Johnson/Roy Gould AV 258-4602/2910

AGENCY: OMEW WSMR NM

STATUS: Operational

COMPUTER: EAI 7800 analog computer with full hybrid linkage and EAI PACER 100 and EAI 3200 digital computer.

LANGUAGE: FORTRAN IV, Hybrid Operations Interpreter, Assembler for EAI PACER 100 and EAI 3200.

FIRST BATTLE

1. PURPOSE

Designed to provide division command groups the opportunity to control and coordinate combined arms operations in a simulated tactical environment against an appropriate opposing force.

2. DESCRIPTION

FIRST BATTLE is a two-sided, manual, simulation system, which may be run using 1:50,000 or 1:25,000 scale topographic maps. OPFOR units are played at the battalion level and US units are played at company level. Each unit has a relative combat power and when engagements between two opposing forces occur, both sides are attrited using simplified probability tables which reduce the combat power value in each succeeding engagement. The rules for maneuver and combat resolution allow participants to exercise any scenario on any terrain.

3. RBC CAPABILITIES

a. Commo jamming, DF, chaff, weather, and day/night are played explicitly. Obscurants with the exception of dust are played explicitly. All facets of terrain (i.e., woods, civilian population centers, roads, obstacles, built-up areas) are played implicitly. Electronic Warfare Support Measures (ESM) in the form of monitoring, provide radio/radar frequencies to be DF'ed which can then be either targetted for intelligence, jamming or destruction. Intercept, targetting and destruction are determined by vulnerability tables and die roll. Chaff can be fired by one unit and it will conceal one other firing unit.

b. The chaff-firing unit cannot fire other ordnance while firing a chaff mission. Weather conditions degrade or enhance target acquisition by radar or electronic collection means. Smoke is considered in visibility, spotting, and acquiring in all weapons systems effects in the combat results tables. Movement rates (MV's) are assigned to each type unit. MV's are appropriately enhanced or reduced by the trafficability of terrain, road networks, etc. EW jamming reduces MV's by one half.

4. MODEL LIMITATIONS/RBC GAPS

Does not represent Divarty in sufficient detail to account for target acquisition assets for counterfire capability.

5. INPUTS AND SOURCES

INPUT	SOURCE
EW supplement, Pd tables, Combat results tables, Weapons effects	ARI, AMSAA, Air Force Tactical Studies, Attack Helicopter Instrumented Test Phase I, II, Legal Mix V, Joint Munitions Effectiveness manuals, military judgement and experience.

6. REQUIREMENTS

None identified for prototype. Will be addressed after production model is fielded.

7. MODEL IMPROVEMENTS

Continuous refinement of model to achieve improved methodology/data base.

CONTACT: MAJ Doug Nolen AV 552-3395/3180

AGENCY: CATRADA Ft Leavenworth, KA

STATUS: Operational

COMPUTER: None

LANGUAGE: N/A

FOURCE MODEL

1. PURPOSE

FOURCE is designed to emphasize the representation of staff performance and combat information/intelligence flow in order to measure the relative combat effectiveness of command and control(C^2) and intelligence systems alternatives in force-on-force combat.

2. DESCRIPTION

FOURCE is a computerized, two-sided, division-level, deterministic model composed of four functional areas. The "control function" acts as an executive routine to handle input/output and exogenous events. The "perform staff functions" provides a perceived battlefield for the several echelons in terms of unit status, residual combat effectiveness, relative combat power, range to enemy, unit location, etc. The "control and direct the battle" function is where decisions concerning combat actions, maneuver and resource allocation are made, based on a detailed combat rule structure designed to simulate the results of the C^2 decision process. "Fight the battle" function, is where the actual maneuver of battalions, artillery, command posts and sensors results in target acquisition and engagements for combat scoring.

3. RBC CAPABILITIES

Realistic battlefield conditions modeled in FOURCE are communications jamming and the use of direction finders. The Commo Jamming code calculates, for a given CP radio receiver, the S/N for each transmitter and the time delay to successfully transmit the message under jamming conditions. The Direction Finder code provides, for each DF location, the kind of target intercepted (CP, radio or jammer.)

4. MODEL LIMITATIONS/RBC GAPS

Battalion resolution limits studies that can be done. Effects of EW are not fully integrated with rest of model. Smoke, weather and debris are not represented. Artillery representation requires enhancement and resupply is not treated.

5. INPUTS AND SOURCES

INPUT	SOURCE
Weapon perf. characteristics	Equipment manuals; threat docs, etc.
Sensor perf. characteristics	AMSAA, FSTC
Staff perf. characteristics	TRADOC Test Report
ADP perf. characteristics	"
Jammer power/freq/ant patterns	PMs, Sig. Sch.

Terrain (relief, veg, roads)	DMA, NBS
Decision thresholds	TRASANA, CACDA

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Wpn, veh and sensor performance in the conditions below:	
Aerosols/Smoke/Dust	Non-existent
Fog/haze/rain/snow	Non-existent
Debris	Insufficient quantity/poor qlty
Jamming/df	Insufficient quantity/poor qlty
Chaff	Insufficient quantity/poor qlty
Commo/radar	Unvalidated/unreliable

7. MODEL IMPROVEMENTS

Artillery will be enhanced by adding round selection and battery resolution of volleys. Explicit commo net representation is planned. Smoke and dust will be added. Intelligence systems will be improved. EW will be integrated in performance model.

CONTACT: Dr. Parish AV 258-2327

AGENCY: TRASANA

STATUS: Operational

COMPUTER: UNIVAC 1108

LANGUAGE: 98% FORTRAN, 2% ASSEMBLY

GUIDANCE TEST AND SIMULATION FACILITY (GTSF) MODEL

1. PURPOSE

Engineering design verification of PATRIOT system performance evaluation, specification compliance demonstration and ECM waveform analysis.

2. DESCRIPTION

This is a" hardware-in-the-loop" hybrid simulation. It is PATRIOT-specific. Actual jammers can be inserted in the anechoic chamber.

3. RBC CAPABILITIES

ECM and in-flight environment.

4. MODEL LIMITATIONS/RBC GAPS

Only a few aircraft can be simulated. Search capabilities are not simulated.

5. INPUT AND SOURCE

INPUT	SOURCE
Hardware characteristics or descriptions of equipment.	Hardware and test data and design estimate.

CONTACT: Mr. Joe Kosuck AV 742-3900

AGENCY: PATRIOT PMO

STATUS: Evolving

COMPUTER: CDC 6700, COMCOR 5000, DATACRAFT 6024/5

LANGUAGE: FORTRAN

HELICOPTER MISSION SURVIVABILITY METHODOLOGY (HMSM) MODEL

1. PURPOSE

To provide a common basis for comparing the effectiveness of candidate aircraft survivability equipments (ASE) for Army aircraft operating at or across the FEBA.

2. DESCRIPTION

HMSM is a two-sided, many-on-one, stochastic and deterministic survivability model which models engagement between an AD force and 2-5 helicopters at short range. It simulates a RED regiment with support AD systems versus an anti-tank force team of up to five helicopters. The HMSM system was developed especially for the Army ASE program. The design employed makes use of detailed one-on-one engagement models developed by CALSPAN and other industry and government agencies for representing specific weapon systems and countermeasures interactions and evaluating their effectiveness. The EW representation is contained in these "feeder" models which create input for HMSM. The model is operations-oriented and is designed to use field data when available. Data or estimates obtained from the laboratory or theoretical approaches also can be used. The HMSM system includes models which compute ASE suite costs and aircraft performance penalties allowing tradeoff analyses showing cost and penalty effective equipment combinations.

3. RBC CAPABILITIES

Model has capability of implicitly representing radar jamming, chaff, and radar warning receivers (RWRs). It simulates weather implicitly, in the way of rain, snow/sleet, fog/haze, and wind. It also plays cloud cover, night, light level, smoke, and dust; as well as terrain in land form, vegetation and cultural characteristics. The environmental parameters are represented by a change in the weapon or ASE capability to accomplish particular functions. Examples are: different weapon encounter distributions, weapon engagement range and aspect distributions, detection probability, tracking accuracy, terminal effects and time delays. In general, for effects that alter encounters, engagements or geometries are handled internally, whereas effects that are dependent on a particular geometry are addressed in preprocessor models. For example, radar warning receivers which allow encounter avoidance and alter exposure times are handled internally while a track error inducing format is represented by a new input table of single salvo survival probability given the jammer is working against the threat at the ranges and aspects of interest.

4. MODEL LIMITATIONS/RBC GAPS

Currently, aspect granularity is restricted to 90° segments for front, side and rear, but expanding this is only a matter of available core and redimensioning appropriate arrays. As presently configured, the model is not intend to estimate "realistic" battlefield loss rates. This is not a limitation in ed the strict sense, however, the value of being able to provide such estimates is recognized.

5. INPUT

Inputs are required for describing the aircraft, mission, theater, and ASE. A run consists of a single aircraft, mission and theater combination. The number of equipments within a category (ECM, OCM, IRCM, VR) may be specified as may the number of category combinations. Each equipment or combination, which does not act independently against the threat weapons, requires separate inputs which reflect the effect of the ASE(s) on the threat(s). Example: aircraft survivability to AAA weapon is in part a function of tne vehicle area vulnerable to the projectile as a function of impact speed and aspect. Here, it is represented by a range/aspect-dependent single salvo Pk array. If the candidate ASE suite includes vulnerability reduction (VR) features, a different table must be input to reflect the changes in vulnerable area associated with the VR feature. If the AAA has a radar mode and an error-inducing jammer is part of the ASE suite, the effects are represented as a new Pk array which represents the jammer effects computed off-line by using a feeder model.

6. MODEL IMPROVEMENTS/REQUIREMENTS

Model improvements include, the implementation of updated threat and ASE characteristics, plus modifications to reflect aircraft employment tactics associated with new or modernized aircraft, weapons systems (e.g. HELLFIRE), sensors (TADS) or missions. Technology and threat advances need to be identified so that feeder models can be developed/modified and input prepared which reflects the current and projected conflict environment. Data is needed for these feeder models which are commensurate with the level of detail and confidence desired for the final output. Methodology updates are planned for FY 1981 to accommodate tactics variations, new threats, advanced mission equipments and improved ASE. Expansions being considered include MMW CM (RWR, chaff, jammer), monopulse CM, and advanced detector systems for locating/countering enemy equipments.

CONTACT: Dave Schott (716) 632-7500

AGENCY: Calspan Advanced Technology Center, P. O. Box 400, Buffalo, NY 14225

STATUS: Operational at Calspan

COMPUTER: IBM 370

LANGUAGE: FORTRAN IV

H1 HYBRID GUIDANCE SIMULATOR MODEL

1. PURPOSE

Performance evaluation, pre-and post-flight analyses, special compliance demonstration, and system-level design requirements.

2. DESCRIPTION

A hybrid simulation capable of simulating a few aircraft. It is a detailed engineering-level model directed at solving engineering problems. This model is PATRIOT-specific.

3. RBC CAPABILITIES

Rain, chaff, clutter, multipath CW, and blinking-noise jamming are played.

4. MODEL LIMITATIONS/RBC GAPS

Only simple ECM and a few aircraft can be simulated. It is concerned mainly with system tracking problems and estimating performance.

5. INPUT AND SOURCE

INPUT	SOURCE
Target description, system description	Test data

6. REQUIREMENTS:

None identified

7. MODEL IMPROVEMENTS

None planned since model is being developed.

CONTACT: Mr. Joe Kosuck AV 742-3900

AGENCY: PATRIOT PMO

STATUS: Evolving

COMPUTER: CDC 6700 and COMCOR 5000 ANALOG

LANGUAGE: CDC EXTENDED FORTRAN/FORTRAN

ICOR MODEL

1. PURPOSE

To support the analysis of corps-and division-level interdiction missions, with emphasis on the role of conventional and nuclear fire support, in conjunction with associated intelligence, surveillance, and target acquisition systems.

2. DESCRIPTION

ICOR is an extension of CLEW II, which emphasized the explicit modeling of sensor systems. Like CLEW II, ICOR is a force-on-force wargame that represents individual unit combat, unit maneuvering and the influence of battlefield action and terrain on visual and electromagnetic signatures. ICOR includes an improved artillery and air defense representation, as well as several software design improvements. The interaction of individual air defense sites and aircraft flights is now treated explicitly. ICOR also includes a functional-level simulation of intelligence-collection systems, support processing, and C^3. It operates in an automated and interactive mode to provide situation and intelligence reports on events to "man-in-the-loop" commanders, in support of maneuver and resource allocation decisions. ICOR represents photographic and infrared systems such as the RF-4C, Quick Strike Reconnaissance, and RPV's, as well as radar systems such as the UPD-4, MOHAWK SLAR, and SOTAS. In addition to the imaging systems, signal intelligence systems are represented, including airborne and ground-based systems such as TRAIL BLAZER, AGTELIS, TEAMPACK, GUARDRAIL, QUICK LOOK, TR-1, and TEREC. ICOR nuclear treatment includes prompt effects, collateral damage considerations, terrain impacts (including contaminated areas), and unit behavioral impacts (combat effectiveness, massing, etc.).

3. RBC CAPABILITIES

The model allows for implicit representation of communications jamming, radar jamming of target acquisition/intelligence-collection systems, and explicit treatment of DF, rain, fog/haze, cloud cover, night, and smoke. Terrain, in the way of land form, vegetation, and cultural features, is modeled explicitly.

4. MODEL LIMITATIONS/RBC GAPS

"Man-in-the-loop" dependencies, such as human judgement, learning curves, and player-to-player variations are considered model limitations.

5. INPUTS AND SOURCES

INPUT	SOURCE
Terrain data	Maps
Weapon parameters	JIFFY/DIVWAG Model
Intel/EW parameters	OTs/DTs/ROCs
Initial unit positions/equipment	SCORES, etc.

6. REQUIREMENTS

Improved input/output routines to expedite interactive turn-around, and allow greater numbers of excursions or replications.

7. MODEL IMPROVEMENTS

a. ICOR/VAX - Conversion of ICOR for use on the VAX 11/780 minicomputer.

b. ICOR/CW - Extension of ICOR/VAX to include an explicit representation of chemical warfare.

CONTACT: Francis J. Lynch (703) 821-5108

AGENCY: The BDM Corporation, 7915 Jones Branch Dr., McLean, VA 22102

STATUS: Operational at BDM

COMPUTER: CDC CYBER 176 (Interactive I/O, CDC 7600 or CYBER 176 batch mode.)

LANGUAGE: FORTRAN IV

IMPROVED CONTINUOUS WAVE ACQUISITION RADAR (ICWAR) MODEL

1. PURPOSE

To estimate the probability of detection (P_d) of a target as a function of the target range.

2. DESCRIPTION

The ICWAR model is a digital computer program which simulates the ICWAR function of the low-altitude target acquisition system of the Improved HAWK weapon system. The model accounts for the manual and automatic modes of the actual hardware and simulates clean and jamming penetrators as well as stand-off jammers. The output is the range at which the cumulative P_d is 0.95. An alternative output provides an array of target ranges for values of single scan P_d.

3. RBC CAPABILITIES

RED radar jamming is simulated explicitly. Terrain, in the way of land form, is represented explicitly. Barrage or spot noise jamming of a given power spectral density is an input; jamming range is fixed for stand-off jamming and the same as the penetrating aircraft for self-screening jamming. It also simulates chaff explicitly as well as clutter.

4. MODEL LIMITATIONS/RBC GAPS

Only single source jamming is considered. Only the target acquisition phase of the engagement is modeled. Does not address weather, obscurants or other EW.

5. INPUT

Inputs will specify: (1) Penetrating target altitude, speed, radar cross section, and on-board noise jamming power spectral density and, (2) standoff noise jamming power spectral density, range, and whether on-axis or off-axis. Most inputs used are generated by MIA, and provided by MIRCOM. Other agencies such as DIA also provide inputs.

6. REQUIREMENTS

Adequate knowledge exists to refine and update model. The modeling of multiple source jamming and maneuvering targets will be added when required.

7. MODEL IMPROVEMENTS

A model that will include ARM and counter-ARM is under development.

CONTACT: Mr. Charles Lewis AV 746-5470

AGENCY: MICOM, Redstone Arsenal, AL

STATUS: Operational

COMPUTER: CDC 6700

LANGUAGE: FORTRAN IV

8. COMMENTS/RECOMMENDATIONS

Model information was provided by System Engineering Tactical Ground Defense Systems (TGDS) Raytheon Company, Bedford, MA 01730

IMPROVED HIGH POWER ILLUMINATOR (IHPI) MODEL

1. DESCRIPTION

The IHPI is a digital computer program which simulates the target tracking hardware of the improved HAWK system. The model estimates the probability that an IHPI will lock on a target as a function of target range. The output is the range at which the cumulative P_d is 0.95. An alternative output provides an array of single-scan probability of lock and cumulative probability of lock versus target range for each opportunity to lock.

2. RBC CAPABILITIES

The conditions considered are the implicit representation of radar jamming, clutter, and CCM against deceptive and noise jamming.

3. MODEL LIMITATIONS/RBC GAPS

Only non-jamming, non-maneuvering penetrators are considered explicitly. Only part of the engage phase of the engagement is modeled. Does not address other EW, weather, obscurants or terrain.

4. INPUT

Model inputs specify the penetrating target attitude, speed, radar cross section and range of detection by an acquisition radar.

5. REQUIREMENTS

Adequate knowledge exists to refine and update model. The modeling of maneuvering targets will be added when required.

6. MODEL IMPROVEMENTS

No action to increase the capability of the model is currently planned.

CONTACT: Charles Lewis AV 746-5470

AGENCY: MICOM Redstone Arsenal, AL

STATUS: Operational

COMPUTER: CDC 6700

LANGUAGE: FORTRAN IV

7. COMMENTS/RECOMMENDATIONS

Model information was provided by Systems Engineering, Tactical Ground Defense Systems (TGDS), Raytheon Company, Bedford, MA 01730

INCURSION SUBMODEL OF ADAGE MODEL

1. PURPOSE

The ADAGE simulation is designed to study the effectiveness of BLUE weapon systems mixes in providing air defense to a division. ADAGE is composed of two models: INCURSION and CAMPAIGN. INCURSION is a computerized, analytic, one-on-one combat model that determines ground-to-air defense effectiveness at the fire-unit level for input to the many-on-many CAMPAIGN model.

2. DESCRIPTION

INCURSION is a two-sided, Monte Carlo, combat simulation which determines the effectiveness of one ground-based weapon system engaging one aircraft. The weapon system may be an organic ground system or an air defense weapon, and either a missile or a gun. The aircraft may be fixed wing or helicopter. Two flight modes are simulated; the "fly by" where aircraft is enroute past the weapon, and the "vicinity-of-target" where aircraft is maneuvering to deliver ordnance on a ground target defended by the weapon. In neither case is Incursion a duel; but the ground air defense fire unit may be designated as the target attacked, and data relative to aircraft attrition before/after ordnance release are passed to CAMPAIGN to permit explicit modeling of direct suppression of ground air defenses. Model considers functions associated with a ground-to-air engagement. Intervisibility is modeled through statistical terrain. Detection is by ADA sensor (radar or FLIR) or visual, depending on weapon.

3. RBC CAPABILITIES

RBC represented implicitly are red radar jamming and terrain. In addition, fog/haze, night, smoke, and dust may be simulated implicitly as quantified by met visibility and ceiling. The model plays three types of terrain; rough, rolling, and open. It plays stand-off jamming and escort jamming. For any particular weapon system, model also plays inherent CCM techniques in addition to the switching to optical detection/tracking if radar is jammed, and to IR detection if optical is obscured.

4. MODEL LIMITATIONS/RBC GAPS

Does not play C^3 explicitly, nor commo jamming. Does not play intelligence explicitly. Engagement is strictly ground-to-air, i.e., aircraft fly a tactical flight path representative of a particular mission and do not react to ground fire by mission change or abort. Other capabilities not present include chaff, DF, precipitation and wind, as well as cloud cover and light level.

5. INPUTS AND SOURCES

INPUT:	SOURCE:
Aircraft type descriptor, flight path - (time and xyz coordinates)	Threat Div, Studies Branch, ADS

Weapon placement parameters	Studies Branch, ADS
P_d (visual) tables	VisPoe Model, MICOM
Time pts on flt path for ordn delivery	Threat Div ADS
Jamming (burnthrough)	Threat Div ADS
Met visibility data	VisPoe Model
Night opns parameters	NVL
FLIR, TV, Laser, IR data	PM Office for each weapon system
Weapon sys characteristics (hardwired)	AMSAA, DARCOM, PM

6. REQUIREMENTS

REQUIREMENTS:	AVAILABILITY/INTEGRITY
Aerosols data Smoke/dust/debris Fog/haze Rain/snow Commo/chaff	Non-existent in format necessary to interface with model, i.e., weapons effect, degradation or delay times experienced by each weapon when subjected to each environment/mix.

7. MODEL IMPROVEMENTS

Total software interface between INCURSION and CaAMPAIGN expanded EW capability, and detailed modeling of dual-ammunition capable air defense systems.

CONTACT: Ray Upham AV 978-6238/7500

AGENCY: ADS Ft Bliss

STATUS: Operational - Active

COMPUTER: CDC 6400

LANGUAGE: FORTRAN IV

8. COMMENTS/RECOMMENDATIONS:

The ADAGE model simulates a division area encounter and is used for studies/analyses requiring numerous runs where many alternatives are considered. Due to these applications, mods that address limitations/RBC gaps should be defined, reviewed and perhaps programmed through the TRADOC Model Improvement Program.

IMPROVED PULSE ACQUISITION RADAR (IPAR) MODEL

1. PURPOSE

To estimate the probability of detection (P_d) of a target as a function of the target range.

2. DESCRIPTION

The IPAR model is a digital computer program which simulates the IPAR function of the medium-altitude target acquisition system of the Improved HAWK weapons system. The model accounts for the manual and automatic modes of the actual hardware and simulates clean and jamming penetrators as well as stand-off jammers. The output is the range at which the cumulative P_d is 0.95. An alternative output provides an array of target ranges for several values of cumulative probability of detection, or an array of target ranges for several values of single scan probability of detection.

3. RBC CAPABILITIES

Conditions simulated explicity include RED radar jamming and the deployment of RED chaff. Barrage or spot noise jamming of a given power spectral density is an input. Jamming range is fixed for stand-off jammers and the same as the penetrating aircraft for self-screening jamming.

4. MODEL LIMITATIONS/RBC GAPS

Only single source jamming is considered. Only non-maneuvering penetrators are considered. Only the target acquisition phase of the engagement is modeled. No other EW is played; weather, obscurants and terrain are not addressed.

5. INPUT

Inputs will specify: (a) penetrating target altitude, speed, radar cross section, and on-board noise jamming spectral density and, (b) standoff noise jamming power spectral density, range, and whether on-axis or off-axis. Most inputs used are generated by MIA, and provided by MIRCOM. Other agencies such as DIA also provide inputs.

6. REQUIREMENTS

Adequate knowledge exists to refine and update model. The modeling of multiple source jamming and maneuvering targets will be added when required.

7. MODEL IMPROVEMENTS

A model that will include ARM and counter-ARM is under development.

CONTACT: Mr. Charles Lewis AV 746-5470

AGENCY: MICOM, Redstone Arsenal, AL

STATUS: Operational

COMPUTER: CDC 6700

LANGUAGE: FORTRAN IV

8. COMMENTS/RECOMMENDATIONS

Model information was provided by System Engineering, Tactical Ground Defense Systems (TGDS), Raytheon Company, Bedford, MA 01730.

INFRARED SIMULATION SYSTEM (IRSS) MODEL

1. PURPOSE

The IRSS is a simulation tool for the design, development and evaluation of IR sensors applicable to surface-to-air, air-to-air, and air-to-surface missiles.

2. DESCRIPTION

Sensors in the 0.2 - 0.4 and 1.0 - 5.0 micron bands are hybrid computer-controlled in 6 degrees-of-freedom. A target generator simulates a variety of target-background combinations which include tailpipes, plumes, flares, and fuselages in single or multiple displays against a clear, cloudy, overcast, or sunlit sky. These images are then displayed in azimuth, elevation, range and aspect angle(s) by the target-projection subsystem through a folded optical network, a display arm and a display mirror simulation capability, and ranges from open-loop component evaluation to closed-loop total system simulation.

3. RBC CAPABILITIES

Two main types of IRCM devices can be simulated at this time: CW-modulated jammers and flare decoys. IRCM devices are simulated using specially-built infrared projectors. For jammers, they consist of an IR source which is mechanically modulated at any frequency (or combination of frequencies.) Flares are simulated by a high intensity IR source which can be amplitude-modulated to simulate a particular flare time history.

4. MODEL LIMITATIONS/RBC GAPS

Lack of EO defeating obscurants.

5. DATA INPUTS/SOURCES

INPUT	SOURCE
IRCM device features	Customer
Flare performance	"

6. REQUIREMENTS

None identified

7. MODEL IMPROVEMENTS

A pulse jammer simulation is under development.

CONTACT: Dr. John Johnson AV 746-2755

AGENCY: Advanced Simulation Center MICOM

STATUS: Operational

COMPUTER: INTERDATA 70/CDC 6000

LANGUAGE: FORTRAN

8. COMMENTS/RECOMMENDATIONS

IRSS is an extremely powerful tool for design evaluations.

INTEGRATED TEST FACILITY (ITF) MODEL

1. PURPOSE

ITF was developed to permit explicit simulation of complete military satellite communications systems, or selected segments of such a system, enabling evaluation of: system performance, integration and interface areas, reported field problems, and any other salient characteristics or parameters.

2. DESCRIPTION

The ITF is a major component of the SATCOM Ground Subsystem Evaluation Facility. It is an engineering test complex which consists of two major elements: the Terminal Equipment Test Facility (TETF) and the Network Test Facility (NTF). The TETF comprises various modems, multiplex, converter, power test and data acquisition equipment.

3. RBC CAPABILITIES

Satellite communications jamming and rain are modeled. Specific jamming considerations include: CW, AM, FM, Pulsed, PSK, QPSK, 2-tone, spread spectrum, noise, and frequency shift-keyed (frequency hopping). The commo performance capability is degraded during heavy rain and degraded or destroyed during the period of jamming.

4. MODEL LIMITATIONS/RBC GAPS

The ITF does not include path delay time, although effects of time delays, if required, are possible by other means. The existing doppler simulator is not entirely adequate.

5. INPUTS AND SOURCES

INPUT	SOURCE
Scenario of communications and selection of terminal types to be modeled.	Initiating Agency

6. DATA REQUIREMENTS FOR IMPROVEMENT

Long range planning inputs covering types of communications and evaluation criteria and supporting threat information.

CONTACT: S. Findler/J. Bell AV 992-2504

AGENCY: Satellite Communications Agency, Ft Monmouth, NJ

STATUS: Operational

COMPUTER: PDP-8/HP-2112

LANGUAGE: FORTRAN/FORTRAN IV

JIFFY MODEL

1. PURPOSE

JIFFY is a war gaming process developed by CACDA and operated at Ft Leavenworth for scenario development and force structure evaluations.

2. DESCRIPTION

JIFFY is a two-sided, computer-assisted, low-resolution war game. Players manipulate forces using maps and performance indicators to simulate ground combat. The gaming process is capable of playing virtually any force size. Resolution is to desired level, normally BLUE company and RED battalion. The manual functions of the game are those aspects of military operations that are associated with doctrine and tactics, and include the commander's concept of the situation, the allocation of forces, terrain analysis, movement/map maneuver, engage/disengage criteria, and the distribution of personnel and materiel replacements. Some of the functions are computerized, e.g., rate-of-advance calculations, attrition routines, and bookkeeping chores.

3. RBC CAPABILITIES

Realistic conditions simulated implicitly in Jiffy are fog/haze, night combat operations, smoke and terrain. The two environmental factors of interest are terrain, as it affects rate-of-movement and restriction to visibility, as it affects an observer's ability to detect/acquire enemy weapons systems. Commo/commo jamming are played subjectively by gamers according to their effects on rate of advance and artillery rate-of-fire.

4. MODEL LIMITATIONS/RBC GAPS

No specific unit geometry is played. Weapon system in one sector cannot engage a weapon system in another sector. Assessments are generally nonlinear aggregates of one-on-one duels. Ammo expenditures reflect only rounds fired at enemy and not rounds lost to combat damage. Radar jamming, DF, and chaff are not addressed in the model.

5. INPUTS AND SOURCES

INPUT	SOURCE
Force structures	CACDA, TRADOC
Wpn/ammo codes	JIFFY Internal
Firepower scores	CAA
Fractional damage tables	AMSAA
Armor single shot kill prob.	AMSAA
AH single shot kill prob.	AMSAA

AD single engagement prob.	Divad/Stinger COEA
Acquisition capabilities under degraded conditions	NVL/AMSAA/CACDA limited visibility model

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Aerosol	Insufficient quantity
Smoke	Insufficient quantity
Jamming	Insufficient quantity

7. MODEL IMPROVEMENTS

Chem casualties routine - assessments due to chemical operations.

CONTACT: Dave Farmer AV 552-5258

AGENCY: CASAA, Ft Leavenworth, KS

STATUS: Operational

COMPUTER: CDC 6400/6500

LANGUAGE: FORTRAN IV (Extended)

H4 SIX-DEGREE-OF-FREEDOM (6DOF) INTERCEPTOR MISSILE SIMULATION H4D, H4H, H4B, (MGM) MODELS

1. PURPOSE

To determine missile performance against a target after the engagement decision has been made.

2. DESCRIPTION

The H4 family models includes: H4D - Improved HAWK (IH) 6-DOF Digital Missile Model; H4H-IH 6-DOF Hybrid Missile Model; and H4B-IH 6-DOF Hybrid Missile model with missile seeker, autopilot and elevon actuators" in-the-loop". These models function at the battery level and are used to evaluate missile performance against benign, jamming, maneuvering, and multiple targets. All three simulations are operational and have been verified against flight test data.

3. RBC CAPABILITIES

H4B capabilities include explicit representation of clutter, ECCM and radar jamming. H4D/H4H capabilities include only radar jamming, in the form of a single-target wideband noise barrage jammer. The H4B considers barrage jammers, blinking jammers, velocity gate pull off (VGPO), and SOJs. Barrage jamming is modeled in all H4 models. Multiple blinking jammers produce sudden shifts in the angular position of the guidance signal. VGPO affects seeker and autopilot logic. SOJ affects the guidance signal derived by the seeker. Missile hardware is required "in-the-loop" for these three types of jammers. It should be noted that only jamming of the missile seeker is considered in the simulators and there is no provision for jamming missile rear or HPI.

4. MODEL LIMITATIONS/RBC GAPS

H4B - Certain spectral inputs as seen by the missile seeker (e.g., clutter) must be approximated by a single frequency. There are also maximum power limitations where simulating ECM targets. H4D - The missile receiver model is highly simplified in order to have a reasonable run-time/real-time ratio. Thus, dynamic seeker AGC response to fades is not modeled explicitly.

5. INPUT

Inputs for the models include: missile hardware values and missile noise, target glint and fading, and ECM environment parameters. Most inputs are generated by MIA and provided by MIRCOM.

6. REQUIREMENTS

Adequate knowledge exists to refine and update the models.

7. MODEL IMPROVEMENTS

All models adequately fulfill their present purpose. Long term improvements to the H4D would involve a high speed digital model of the missile seeker interfaced to the autopilot. Work is currently in progress to model clutter and ECM in the missile rear for the H4B model.

CONTACT: Charles Lewis AV 746-5470

AGENCY: MICOM, Redstone Arsenal, AL

STATUS: Operational

COMPUTER: CDC 6700

LANGUAGE: FORTRAN

8. COMMENTS/RECOMMENDATIONS:

Model information was provided by Systems Engineering, Tactical Ground Defense Systems (TGDS), Raytheon Company Bedford, MA 01730.

MODEL OF WARSAW PACT COMMAND AND CONTROL-TACTICAL (MPACT) MODEL II

1. PURPOSE

MPACT is used to evaluate the effectiveness of BLUE radar and communications jamming, jamming and benign decoys, and limited lethal defense-suppression systems versus a netted SAM/AAA/GCI/AI air defense system. Emphasis is on the simulation of radar-directed air defense systems and associated command and control systems including voice and digital communications between elements.

2. DESCRIPTION

MPACT is a time-stepped, event-conditioned, Monte Carlo simulation of multiple aircraft striking targets defended by SAM/AAA/AI defense systems. It simulates up to 1200 aircraft versus up to 100 air defense physical locations in a combined arms Army-size scenario. The model uses deterministic algorithms to calculate engagement opportunities and Monte-Carlo algorithms to assess engagement outcomes. Engagement opportunity algorithms are sensitive to direct attack, radar jamming, communications jamming, and decoy dilution of air defenses. Engagement outcomes are assessed using a Monte-Carlo algorithm and average probability of kill values for either a jamming, benign, or optical back-up engagement condition. Strike aircraft are simulated with five-degrees-of-freedom utilizing approximations for pitch and bank angle. Matrix inputs are used to describe RCS and jammer antenna patterns. The radar beams are modeled using a keyhole algorithm that simulates the main beam and an average sidelobe. Each radar can be simulated as part of an explicit model of its command, control, and communications system or it can be simulated as being autonomous from any centralized control. The model contains the GCI and fighter interceptor/airbase routines from the MECCA model; however, these routines haven't been fully integrated.

3. RBC CAPABILITIES

MPACT provides a detailed simulation of multiple RF jammers versus multiple RF sensors and communications receivers. It calculates either S/N or J/S levels as a function of the jamming environment and compares them to input detection thresholds. The COMJAM code uses an input signal strength for each receiver from its primary signal source. Command and control time delays are a function of traffic load and the link that remains operable. MPACT contains a detailed simulation of the early warning network which can be used to simulate centralized control of SAM systems. An optical track mode is simulated if a SAM's acquisition and/or track radar is effectively jammed. Terrain masking is simulated via site masking table inputs for several azimuth angles and one range value.

4. MODEL LIMITATIONS/RBC GAPS

MPACT only has a limited capability to simulate visual, EO, IR, or optical detection/tracking systems. It does not consider the effects of weather, obscurants, or light level. Due to these problems, a lack of terrain masking detail, and a limited terminal engagement simulation MPACT should not be used

to estimate attrition. Moreover, MPACT is hardwired to represent RED air defense system operations.

5. INPUTS AND SOURCES

DATA INPUT	SOURCE
Offensive weapon lethality	AF/ADTC
Defensive weapon lethality	AF-EWES, other models
A/C performance data	Dash 1, SPO, Test rpts
ECM equipment parameters	ASD, AFEWC, Tech rpts
SAM/AAA/GCI system parameters	DIA/FTD
Target array (scenario)	SCORES
Jammer antenna patterns	RADC, Test rpts
Airbase fighter interceptor Data	DIA/FTD
Communications data	Intelligence sources

6. REQUIREMENTS

DATA REQUIREMENTS	AVAILABILITY/INTEGRITY
In general	Most data is available, the problem is to locate it and convert it to the correct format.
Defensive weapon lethality	All desirable combinations and conditions would be too expensive to generate and keep current.

7. MODEL IMPROVEMENTS

MPACT is being redesigned using top-down design techniques to incorporate fully reactive A/C flight paths, improved communications algorithms, and detailed terminal engagement algorithms.

CONTACT: Major Glen Harris AV 682-2676

AGENCY: TFWC/SA, Nellis AFB, Nev

STATUS: Redesign

COMPUTER: IBM-370

LANGUAGE: FORTRAN IV

MISSILE SEEKER, ARMING AND FUZE RECEIVER (MSAF) MODELS

1. PURPOSE

To model a monopulse inverse receiver, guidance integrated fuze arm system, and semi-active fuze receiver.

2. DESCRIPTION

Improved HAWK (IH) Seeker Model, IH Arming Model, and IH Fuze Receiver Model. These three digital computer programs model operations at the battery level because they simulate missile sub-assembly hardware. These models are used to simulate the end-game portion of a missile intercept and to evaluate the resultant fuze arming and fuzing performance of the IH missile.

3. RBC CAPABILITIES

Model provides an implicit representation of terrain to include land form and vegetation. Also, it provides for the explicit representation of chaff as well as Velocity Gate Pull Off (VGPOs), narrow-band noise jammers, blinking jammers and tone jammers, all directed at the missile seeker. Under weather: rain, fog/haze, and snow/sleet are considered as obscurants. The effect they produce is attenuation of the target's signal strength return.

4. MODEL LIMITATIONS/RBC GAPS

Guidance simulation has simple autopilot control loop, head tracking loop and missile aerodynamic characteristics. Missile model has one-channel tracking capability.

5. INPUT

Model inputs include threat signature in benign environment; threat signature in an ECM environment and intercept and endgame parameters. Most input data is generated by MIA/DIA and provided by MIRCOM.

6. REQUIREMENTS

Adequate knowledge exists to refine and update models.

7. MODEL IMPROVEMENTS

Effort has been initiated to add a rear receiver model.

CONTACT: Charles Lewis AV 746-5470

AGENCY: MICOM Redstone Arsenal, AL

STATUS: Operational

COMPUTER: CDC 6700

LANGUAGE: FORTRAN

3. COMMENTS/RECOMMENDATIONS

Model information was provided by Systems Engineering, Tactical Ground Defense Systems, Raytheon Company, Bedford, MA 01730.

MULTIRADAR MODEL

1. PURPOSE

MULTIRADAR was developed to study the effects of power management jamming against expected ROLAND deployments.

1. DESCRIPTION

The model is a digital computer-based model that simulates the play of an aircraft versus a deployment of ROLAND weapon systems. The model determines the loading a power-managed jammer would have to contend with to defeat the ROLAND systems. The jammer loading information determined from Multiradar represents an intermediate result needed to describe the effectiveness of ROLAND against power-managed jammers.

3. RBC CAPABILITY

Model represents the application of power-managed jamming against ROLAND.

4. MODEL LIMITATIONS/RBC GAPS

Multiradar only considers power-managed jamming and does not consider terrain or ROLAND track radar jamming.

5. INPUT REQUIREMENTS

Model requires the following input data: ROLAND antenna spin rates and beam widths, and target flight path.

CONTACT: Mr. Ronald Halahan AV 283-4650

AGENCY: US Army Materiel Systems Analysis Activity, Aberdeen Proving Ground, MD

STATUS: MULTIRADAR is operational

LANGUAGE: FORTRAN V

COMPUTER: UNIVAC 1108

OTOALOC MODEL

1. PURPOSE AND DESCRIPTION

OTOALOC is used to determine the characteristics and errors in foreign time-of-arrival emitter locators. OTOALOC is implemented on a mini-computer.

2. RBC CAPABILITY

The model represents the performance of time-of-arrival positioning system.

3. INPUT REQUIREMENTS

As inputs, the model requires the location of flank status relative to the center station and the time delay in the received signal at the flank status relative to the center station.

4. MODEL LIMITATION

The model assumes that the TOA stations are deployed in a straight line and that delays due to bending of the signal's path are negligible; neither of these limitations is considered serious.

CONTACT: Mr. Fred L. Washburn, Jr. AV 274-7436

AGENCY: US Army Foreign Science and Technology Center, DRXST-ESI, 220 7th St, Charlottsville, VA 22901

STATUS: OTOALOC is operational

COMPUTER: WANG 2200

LANGUAGE: Basic

PATRIOT COMMUNICATIONS (PATCOM) MODEL

1. PURPOSE

PATCOM is used to evaluate the PATRIOT communications links under jamming conditions.

2. MODEL DESCRIPTION

PATCOM is a computer model that calculates the probability of successfully transmitting a message over any one of many possible paths between two specified PATRIOT terminals which are part of a communications network. The model can be adapted to reflect ADDS, JTIDS, or PLRS* data communications systems.

3. RBC CAPABILITIES

The model considers the land form and communications jamming in modeling multi-routed point-to-point communications. The effects of pulse, swept, and barrage-type jamming threats are considered, and multiple jammer locations can be represented.

4. EW DATA INPUT/REQUIREMENTS

- o Communications site locations
- o Jammer locations as a function of time
- o Communications system response to various types of jamming
- o Communications network configuration
- o Digitized terrain representation of the area over which communications are modeled.

5. REQUIREMENTS

Data is needed to verify the assumptions in PATCOM concerning multiple propagation; these data are planned to be obtained during the PATRIOT DT III.

CONTACT: Mr. D. Barthel AV 283-4030/2366

AGENCY: US Army Materiel Systems Analysis Activity

STATUS: PATCOM

COMPUTER: PATCOM has been implemented on a CDC 7600

LANGUAGE: Extended FORTRAN

*ADDS - Automated Data Distribution System
JTIDS - Joint Tactical Information Distribution System
PLRS - Position Location Reporting System

PEGASUS MANUAL WARGAME (CPX)

1. PURPOSE

Designed to exercise brigade/battalion commanders and their staff in the control and coordination of combined arms operations. It can be used by one, or up to three battalion command groups and a brigade command group.

2. DESCRIPTION

PEGASUS is a command post exercise (CPX) control system that uses a free-play, manual simulation conducted on a 1:12500 scale map board. The map is overprinted with a hexagonal grid system to control movement. The simulation is conducted by US and OPFOR controllers who maneuver forces and conduct engagements in a free-play mode according to game rules. Combat results tables are used to resolve direct/indirect fires, minefields, air defense, CAS, air assault and chem/nuc effects. Tables are stochastic and are entered by a single die roll.

3. RBC CAPABILITIES

Commo Jamming and DF are modeled implicitly or explicitly for RED and BLUE; however EW is handled somewhat differently. BLUE forces use tactical commo during exercise; hence, jamming can be simulated readily. Also, movement of unit, being jammed is degraded. Commo among RED controllers is word of mouth, and jamming is depicted by degrading movement. DF is handled in a random manner. The effects of darkness (night) are portrayed by constraints on movement rates and observation distances. Smoke is limited to indirect-fire delivery means, and covers a specific area of terrain, dependent on number of rounds fired and size/type weapon. CCM to jamming is option of unit being jammed and is governed by unit SOP.

4. MODEL LIMITATIONS/RBC GAPS

The combat results tables for the tank main gun do not address the different types of tank ammo. The air support tables do not provide for the use of 7.75in rocket or 20mm against tanks. EW, weather, smoke, etc. have also been oversimplified to allow for a real-time simulation. Indirect-fire is only smoke delivery means available.

5. INPUTS AND SOURCES

INPUT	SOURCE
Combat results tables	TMs, TRADOC, JMEMs, AFSM Model
Game rules	TRADOC, Internal
Long thrust data base	CA Training Board

6. REQUIREMENTS

Not Defined.

7. MODEL IMPROVEMENTS

Improvement and refinement of combat results tables and simulation methodology.

CONTACT: LTC Jimmie J. Heathman AV 552-3395/4669

AGENCY: CATRADA, Ft Leavenworth, KS

STATUS: Operational

COMPUTER: None

LANGUAGE: N/A

RADAR RANGE MODEL

1. PURPOSE

Model was developed by Navy at Naval Research Lab, circa 1968. It is an engineering model developed initially to assist in the design of radars and in the analysis of their performance.

2. DESCRIPTION

RADAR RANGE is a computerized analytical model which uses the classical radar range equation to calculate the maximum range based on inputs of transmitter/receiver performance and environmental characteristics.

3. RBC CAPABILITIES

Although no RBCs are played explicitly, a capability exists for the model to represent the effects of fog/haze and either (not both) RED or BLUE radar jamming. With data available, model can play rain, snow/sleet, smoke and dust.

4. MODEL LIMITATIONS/RBC GAPS

Explicit radar jamming and chaff are not played. Model uses 1968 Atmospheric Data Base.

5. INPUTS AND SOURCES

INPUT	SOURCE
Transmitter/receiver characteristics	DARCOM/TM
Tgt cross-sectional area	DARCOM/TM
Swerling (cases)	DARCOM/TM
Prob of detection	DARCOM/TM
False alarm probability	DARCOM/TM
Standard atmospheric parameters	National Bureau of Std's, Institute of Telecommunication Systems

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Atmospheric data base update (if required/necessary)	Old (1968)

7. MODEL IMPROVEMENTS

None planned by TRASANA at present time.

CONTACT: Mr. Bob Bennett AV 258-5208

AGENCY: TRASANA, WSMR, NM

STATUS: Operational

COMPUTER: UNIVAC 1108

LANGUAGE: FORTRAN V

RADIO FREQUENCY SIMULATION SYSTEM (RFSS) MODEL

1. PURPOSE

RFSS is designed to enhance the capabilities in all phases of missile system research, design, development, and engineering. The primary application is "hardware-in-the-loop" evaluation of active, semi-active, and passive homing systems, as well as beamrider, track-via-missile, or track-from-ground command guidance systems for surface-to-surface, surface-to-air, air-to-air, and air-to-surface missiles.

2. DESCRIPTION

The model simulates a weapon system's total mission from target search and missile launch through intercept. Guidance sensors and flight control systems perform in an environment where aerodynamic moments, angular motions, and electromagnetic signals are realistically produced. Engagement scenarios include the use of jamming signals generated by simulated or actual jammers "in-the-loop," multiple targets; and simulation of clutter, multipath, glint, and scintillation phenomena.

3. RBC CAPABILITIES

Denial or deceptive jamming techniques can be simulated with present equipment. Two denial ECM channels can be used either to simulate a SOJ or a broadband on-board noise jammer in a self-screen jammer mode. Deception jamming techniques can be accomplished by proper modulation. Present ECM generation capability includes Gaussian and Binary noise, linear FM, square wave, swept square wave, sawtooth and several others.

4. MODEL LIMITATIONS/RBC GAPS

Model limitation includes lack of chaff and lack of ability to simulate more than two ECM sources.

5. EW DATA INPUT

Operational characteristics of EW equipment: antenna patterns, output power, internal logic, waveforms, frequency, glint, multipath, clutter data, and radar cross-section of target.

6. REQUIREMENTS

None identified

CONTACT: Mr. F. M. Belvose AV 746-7196

AGENCY: MICOM

STATUS: Operational

COMPUTER: DATACRAFT 6024/1,/6,
5-Interdata 80, 1-85, Floating Point Systems AP120B

LANGUAGE: FORTRAN, ASSEMBLER

7. COMMENTS/RECOMMENDATIONS

This is an extremely large computer and general purpose system. Its only shortcomings are noted in paragraph 4. It is well suited to the mission of design evaluations. New computer facility, operational circa 1982, will include four (4)-SEL (System Engineering Lab) 3277 and six (6)-AP 120B using FORTRAN and assembler language, respectively.

ROLAND JAMMING (ROLJAM) MODEL

1. PURPOSE

ROLJAM was developed to determine the effects of noise jamming on the ROLAND acquisition radar.

2. DESCRIPTION

ROLJAM is a digital, computer-based model that determines the reduction in potential engagements by ROLAND against enemy aircraft due to a reduction of ROLAND acquisition radar performance by CW noise emitted from a stand-off jammer or escort jammer.

3. RBC CAPABILITIES AND LIMITATIONS

ROLJAM can consider (and is limited to) the quantification effects of one or more CW jammers against the ROLAND acquisition radar.

4. INPUT REQUIREMENTS

ROLJAM requires a description of the jammer flight path and a technical description of the CW jammer system.

CONTACT: Mr. Ronald Halaham AV 283-4650

AGENCY: US Army Materiel Systems Analysis Activity, Aberdeen Proving Ground, MD

STATUS: ROLJAM is operational

COMPUTER: CDD 7600

LANGUAGE: FORTRAN

EW-ROLSIM MODEL

1. PURPOSE

To provide expected performance data for the ROLAND system when subjected to ECM.

2. DESCRIPTION

EW-ROLSIM is a one-on-one, digital computer simulation of the ROLAND system against an adversary with up to four active ECM penetration aids plus chaff. The EW-ROLSIM simulation provides data on the US ROLAND system performance at a 40-msec rate plus an end-game (intercept) evaluation. In performing this simulation, the following US ROLAND subsystems are modeled: target track radar, IR tracker, beam tracker, command and control link (fire unit to missile), and missile warhead. Presently the only target modeled is the MQM-34D Drone. The particular jamming scenario to be considered is selected prior to the initiation of a simulation run; as such, no dynamic threat assessment is made.

3. RBC CAPABILITIES

Various kinds and configurations of active jamming are considered. Jammers modeled include: deceptive jammers, range gate pull-off, dual frequency, dual skirt, detection denial, broadband noise, spot noise, and CW. Up to four active jammers can be considered simultaneously. In addition, chaff is also represented for activating the radar jammers.

4. MODEL LIMITATIONS/RBC GAPS

The most serious model limitation identified with EW-ROLSIM is its lack of consideration for terrain clutter. To enhance the utility of EW-ROLSIM there is a need for obtaining more target representations (RF cross section models), to include representations of field test targets such as drones and enemy aircraft, and better characteristics of threat jammers.

5. INPUT REQUIREMENTS

Required input parameters are ROLAND operating modes, target characteristics, and jammer characteristics (waveform, antenna pattern, frequency and bandwidth).

6. IMPROVEMENTS

Future efforts will focus on providing data on an increasing number of jammers and targets for consideration by EW-ROLSIM.

7. COMMENTS

The EW-ROLSIM simulation is an outgrowth of the ROLSIM simulation program which was initially prepared by the European developers of ROLAND. General Research Corporation was the developer of EW-ROLSIM. This model is presently operational on the ABMDA computer at Huntsville, Alabama. The model is under

the auspices of the US ROLAND Office, Office of Missile Electronic Warfare (WSMR). General Research Corporation, Huntsville, prepared this model and has the access and operational expertise to operate this simulation; however, the model is the property of the US Government. This model is documented in: Electronic Countermeasures Applied to the ROLAND 6-DOF Simulation Volume 1 - User's Manual (U) Volume II - Analysts' Manual (U) by: R. Jacobs, M. Aitken, August 1978, HGRC 78-4490.

CONTACT: Mr. Clarence F. Klaassen AV 258-3808
Mr. William D. Guthrie AV 746-1647

AGENCY: OMEW, White Sands Missile Range, NM
US ROLAND Project Office, Redstone Arsenal, AL

STATUS: EW-ROLSIM is operational

COMPUTER: Presently installed on a CDC 7600

LANGUAGE: FORTRAN

SADS VI MODEL

1. PURPOSE

To determine the system capability of SADS VI in an ECM environment.

2. DESCRIPTION

This is a digital model of a specific radar directed air defense system. The radar capability will be determined experimentally and then modeled.

3. RBC CAPABILITIES

ECM

4. MODEL LIMITATIONS/RBC GAPS

Not model dependent, model will be adapted to test data.

5. INPUTS AND SOURCES

INPUT	SOURCE
To be determined from test data	Test data

6. REQUIREMENTS

To be determined

7. MODEL IMPROVEMENTS

None identified yet

CONTACT: John Baldwin AV 258-4268

AGENCY: OMEW, WSMR NM

STATUS: Under development

COMPUTER: PDP-11/34, NOVA 1210

LANGUAGE: RT-11 & FORTRAN

SAM-D (PATRIOT) JAMMING (SAMJAM II) MODEL

1. PURPOSE

To analyze the target detection performance of the PATRIOT missile system's multi-function array radar in various threat environments.

2. DESCRIPTION

In all EW environments, the specific environment is analyzed in great detail to determine its effect on the PATRIOT radar. The model determines, on a pulse-to-pulse basis, the signal-to-noise ratio (and thus the probability of detection) at the radar receiver, based on target environmental characteristics, including EW.

3. RBC CAPABILITIES

SAMJAM II considers SOJs, SSJs, and ESJs employed by RED against the PATRIOT radar. It also plays chaff, clutter, and rain.

4. MODEL LIMITATIONS/RBC GAPS

The model concerns only PATRIOT radar detection capabilities and does not analyze the entire weapon system. SAMJAM only models the simplest jamming signal threats, e.g, only white barrage noise.

5. EW DATA INPUTS

- o Target Characteristics: altitude, heading, velocity.
- o RCS Jamming Characteristics:
  number, type (SOJ, ESJ, SSJ), alt. range, ERP.
- o Chaff Characteristics:
  location, volume occupied, RCS flight path data.

6. REQUIREMENTS

None identified

7. MODEL IMPROVEMENTS

None planned other than debug of current version.

CONTACT: Hal Harrelson AV 290-3160

AGENCY: ERADCOM CM/CCM

STATUS: Operational

COMPUTER: UNIVAC/IBM

LANGUAGE: FORTRAN V/IV

SIGNAL INTELLIGENCE/ELECTRONIC WARFARE (SIGINT/EW) MODEL

1. PURPOSE

To quantify the impact of signal intelligence and electronic warfare (SIGINT/EW) on combat effectiveness.

2. DESCRIPTION

The model is currently conceptual but is envisioned as a two-sided, corps-level model. As a minimum, it should include the network, sensor, processing/decision, and combat effectiveness modules. Each module will consist of a model or group of models and supporting data base(s). Its resolution should be to company level.

3. RBC CAPABIBILITIES

Explicit representation of RED/BLUE communications jamming, radar jamming and DF, with possible chaff capability.

4. INPUT

TBD

5. REQUIREMENTS

TBD

6. MODEL IMPROVEMENTS

None

CONTACT: Mr. Ferny Payan AV 258-1506

AGENCY: TRASANA

STATUS: Developmental (Contract)

COMPUTER: TBD

LANGUAGE: TBD

SPREAD SPECTRUM MODEL

1. PURPOSE

To analyze and compare different types of spread spectrum communications systems

2. DESCRIPTION

The model uses purely analytical techniques, no stochastic modeling of processes. Output consists mainly of the probability of bit- and word-error as a function of coding, S/N, J/S, signal modulation, jamming modulation, jammer power, bandwidth, frequency, and multiple user environment.

3. RBC CAPABILITIES

Communications jamming with several types of modulation techniques are considered. Also multiple user interference is modeled.

4. MODEL LIMITATIONS/RBC GAPS

Propagation characteristics and transmitter-receiver-jammer geometries are not modeled explicitly. Only two types of spread spectrum techniques (frequency hopping and direct sequence) and two types of modulation (binary frequency shift keyed and coherent phase shift keyed) are modeled.

5. EW DATA INPUT/REQUIREMENTS

INPUT

Signal parameters: S/N, coding, modulation, spectrum spreading method, bandwidth. Jamming Parameters: J/S, modulation, bandwidth, multiple user environment.

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Details of VHF group wave propagation, accurate data on the number and locations of radios/jammers.	Nonexistent - Unvalidated.

7. MODEL IMPROVEMENTS

Incorporation of propagation and geometry models.

CONTACT: Hal Harrelson AV 290-3160

AGENCY: ERADCOM CM/CCM

STATUS: Developmental - Debug

COMPUTER: IBM 360

LANGUAGE: FORTRAN IV

8. COMMENTS/RECOMMENDATIONS

Documentation being completed. With modification, model will run on any computer with a FORTRAN compiler and plotting hardware. Major portions are operational for many analyses of interest.

Tactical AD Computer Operational Simulation (TACOS) MODEL

1. PURPOSE

Originally created by USA Combat Developments Command, Air Defense Agency and BDM for simulating battle between ground-based AD and aerial weapon systems. The model provides analysts and planners an effective vehicle for rapidly measuring the relative effectiveness of AD systems in tactical situations. It has been used in many Army air defense studies since 1965, and the Air Force and NATO have also used it to solve ground-based air defense problems.

2. DESCRIPTION

TACOS is a large scale, operations-oriented, Monte Carlo simulation. It utilizes the output of engineering/system-level models that define weapon systems performance in operational terms. It is capable of analyzing the tactical interactions and intercept parameters inherent in the air defense of targets which can vary from point to area defenses, including the defense of an entire corps area. It can be effectively used for the study of air defense command and control, firing doctrine, relative effectiveness of various systems and system mixes, and force-level analyses.

3. RBC CAPABILITIES

RBC represented explicitly in TACOS are radar jamming, terrain, and IR countermeasures. RBC represented implicitly are cloud cover, rain, fog, haze, night and smoke. The electronic countermeasures submodel represents the effects of noise and deception. Jammers (SOJ and SSJ), weather and smoke are played through the visual detection sub-model, IRCM (flares for IR decoys) are played in the engagement submodel. Home-on-jam is a CCM capability of this model, as is the automatic switching to optical means of detection, if radar is jammed.

4. MODEL LIMITATIONS/RBC GAPS

No C^3 (assumed perfect or autonomous), no commo jamming, DF'ing, or chaff, no explicit intelligence, no movement of forces, no BLUE air, no blinking of radars, no air-to-air represented, and all scenarios must be in one UTM zone.

5. INPUTS AND SOURCES

INPUT	SOURCE
Site locations (UTM)	Studies Branch, ADS
Flight profiles (UTM)	Threat Division - ADS
Radar char (freq bands, gains, etc)	DARCOM, PMs, AMSAA
Jamming loads (noise, deceptive)	Threat Division ADS

Tgt priority scheme (sys vs threat type)	Studies Branch, ADS
Msl char (time of flt curves, vel curves, gimbal limitations, etc.)	DARCOM, PMs, AMSAA
Fidoc as function of range, threat, vehicle type, vel, etc.	Studies Branch, ADS
Pk tables/system/threat type	AMSAA
Critical reaction times Acq to Trk, Trk to fire, etc.	DARCOM, PMs, AMSAA

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Terrain data (with foliage)	Insufficient quantity

7. MODEL IMPROVEMENTS

Expanded ECM, air-to-air engagements, and damage assessment capability. Model should have coordinate system which allows it to cross UTM zones and a method to evaluate the effects of smokes/other RBC. The need for these improvements is recognized; however, no effort toward TACOS modification is currently programmed.

CONTACT: J. Armendariz AV 978-8702

AGENCY: AD School Ft Bliss

STATUS: Operational

COMPUTER: CDC 6500

LANGUAGE: FORTRAN IV

8. COMMENTS/RECOMMENDATIONS

TACOS has the makings of a useful analytical tool for applications in the air defense arena. Since the model is somewhat modular, new features should be readily incorporated. Recommend that improvements needed/identified be considered under auspices of the TRADOC Model Improvement Program.

TAC REPELLER MODEL

1. PURPOSE

To provide a computer tool for investigating attrition of BLUE aircraft by RED ground-based air defense systems, including radar-and IR-guided SAMs, and AD artillery. The model is designed for treatment of few-on-few engagements in detail. Processes modeled include aircraft movement (on prespecified flight paths), threat detection/prioritization, target selection by defensive units, target engagement, and defense suppression. Outcomes of individual engagements within the considered few-on-few scenario are determined by invoking detailed one-on-one engagement models (TAC ZINGER SAM models and P001 Gun Model.) Model output is P_k over time for each individual aircraft.

2. DESCRIPTION

a. TAC Repeller is a mixed, event-stepped and time-stepped, two-sided, Monte Carlo, combat simulation model which treats interactions between BLUE aircraft and individual component units of an integrated array of RED air defense units. "Players" in the simulation are individual BLUE aircraft, RED AD fire units (missile or gun), RED coordinating units which select targets for subordinate fire units, and RED detection radar units. Major processes treated involve movement of aircraft in the battle area, the detection and prioritization of threats, and the selection and engagement of individual aircraft by particular AD fire units. Suppression attacks by aircraft on fire units and coordinating units are also treated. Aircraft movement is on prespecified flight paths. Detection of aircraft by radar and visual means is modeled. Radar detection is based on a form of the radar range equation.

b. Threat prioritization is based on the positions of individual aircraft relative to "defended areas" with associated priorities. Targets are selected for engagement by both the fire units and coordinating units. Aircraft targets are selected for engagement based on assigned priority and projected engagement windows. Individual weapon flyouts are modeled in detail by special versions of the ZINGER models and P001 model. Countermeasures equipment (jammers and flares) carried by aircraft may affect both initial detection and target tracking.

3. RBC CAPABILITIES

a. RBC modeling in TAC REPELLER involves radar jamming and terrain. Terrain is currently represented as seen from specified "viewpoints." Associated with each such "viewpoint" is a set of individual "masks" specified in terms of azimuth limits, range and elevation angle. When an aircraft is behind a given mask as seen from a considered viewpoint, i.e. between the azimuth limits, beyond the range and below the elevation angle, it cannot be detected from that point. Also, jamming signals from that aircraft have an effect at the location of the viewpoint from which the aircraft is masked.

b. Jamming can affect both search and tracking radars. For search radars, only noise jamming is considered. They may be self-screening, escort, or stand-off jammers. Jammers used against search radars are described in terms of power, center frequency, bandwidth, and antenna gain pattern. For each

search radar type, a signal-to-jam threshold must be input. The signal-to-jam ratio for a particular threat must then exceed this threshold for detection to be possible. In calculating jamming signal, the location and orientation of the jammer with respect to the radar are considered, along with gain pattern for jammer and radar. Jamming of tracking radars is modeled in TAC ZINGER models controlled by TAC REPELLER. The particular type of jamming modeled in each of these is the type considered most effective against the particular system represented.

4. MODEL LIMITATIONS/RBC GAPS

The model does not represent weather, obscurants, commo jamming or DF. It does not model ARMs or other CCM. Also, in engagement (tracking and weapon flyout) calculations, only countermeasures employed by the particular engaged aircraft are currently used. Thus, coordinated jamming of tracking radars is not being considered at this time.

5. INPUTS AND SOURCES

INPUT	SOURCE
Aircraft characteristics, i.e., dimensions, RCS, IR signatures.	Sys Cmd (AFSC)
Position data for radars, fire units.	AFIN/USA/Foreign Country Sources
Individual A/C flight paths, pos., vel., orientation.	User
Detection radar parameters, power, freq, sweep rate, S/N threshold for detn., antenna gain pattern.	AFIN/USA/Foreign Country Sources
Terrain data as seen from viewpoints	User
Threat prioritization parameters	User
Command structure	User/AFIN/Army
Target selection parameters	User
Ammo stocks, reload times	AFIN/Army
Jammer char., power, freq. bandwidth, gain pattern	AFSC/AFIN
Countermeasures equipment, jammers and flares carried by individual aircraft	AFSC/AFIN

INPUT	SOURCE
Suppression attacks to be launched by particular aircraft with assoc. Pk's	User, Tests/Models

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
RED radar data	Poor Quality
RED jammer data	Poor Quality

7. MODEL IMPROVEMENTS

There is an ongoing effort to incorporate modified versions of the TAC ZINGER one-on-one Air Defense Engagement Models into TAC REPELLER. These versions contain digitized terrain which will replace the "view-point" characterization presently in use, as described in paragraph 4, "RBC Capabilities". Also to include where appropriate, detailed treatment of clutter and multipath effects on tracking radars.

CONTACT: LTC Walton AV 227-5793

AGENCY: ACS of Studies and Analysis USAF, Pentagon

STATUS: Operational

COMPUTER: Honeywell Multics, IBM 3032, CDC Cyber 176

LANGUAGE: FORTRAN

TAC ZINGER MODEL(S)

1. PURPOSE

To provide an analytical computer tool for investigating attrition of BLUE aircraft by RED ground-based air defense systems including radar-and IR-guided SAMs, and AD Artillery. The model(s) simulates the interaction of a BLUE A/C and a particular Soviet AD system. AD systems modeled are the SA-2 through SA-11. Model is exercised to assist in the assessment of enemy SAM systems using BLUE system performance and RED weapons effectiveness data inputs.

2. DESCRIPTIONS

The TAC ZINGER series simulates the Soviet SA-2 through SA-11. There are 10 ZINGER models. These SAM simulations generate guidance commands and capture major system lags and limits so that the effects of target altitude, speed and maneuver on missile intercept capability can be determined. Countermeasures are employed and degradation due to tracking uncertainties are also included. Missile warheads are also modeled in detail so that P_k's in various scenarios can be generated.

3. RBC CAPABILITIES

Deceptive jammers are modeled in the ZINGER series. These jammers are used to decoy the tracking radars. Terrain is represented and the effects of multipath and clutter on tracking radars are also included.

4. MODEL LIMITATIONS/RBC GAPS

Model does not play commo, commo jamming, DF, chaff, ARM, or other CCM. Weather and obscurants are not considered in the Zinger series. Models are as good as the intelligence data on which they are based.

5. INPUTS AND SOURCES

INPUT	SOURCE
Aircraft characteristics	SPO
Launch site positions	AFIN, DIA, FTD
Individual A/C flight paths	Internal
Tracking parameters (RED)	DIA, FTD
Jammer characteristics	AFEWES, EWC
Terrain data	DMA
Firing doctrine	DIA, FTD

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Terrain data	Insufficient quantity

7. MODEL IMPROVEMENTS

ZINGERS are updated as new or revised intelligence data become available. Modeling techniques are improved on a continuing basis. The incorporation of weather is seen as a viable candidate for future development of model.

CONTACT: LTC Baty AV 227-5793/94/95

AGENCY: HQ, USAF, Pentagon

STATUS: Operational

COMPUTER: Honeywell Multics, IBM 3032, CDC Cyber 176

LANUGUAGE: FORTRAN

TACTICAL AIR DEFENSE BATTLE MODEL (TADBM)

1. PURPOSE

To evaluate the effectiveness of BLUE electronic warfare and lethal defense suppression systems versus a netted SAM/AAA air defense system. Although it is capable of simulating RED-on-BLUE scenarios, it has not been used for this purpose. Hence, the following assumes a BLUE-on-RED application.

2. DESCRIPTION

a. TADBM is a time-stepped, Monte Carlo simulation of multiple aircraft strikes on targets defended by radar-directed air defense systems. It simulates M-aircraft (100 maximum) versus N-SAM/AAA defense sites in a combined arms Army-size scenario. The model utilizes deterministic algorithms to calculate engagement opportunities and Monte Carlo algorithms to assess engagement outcomes. Engagement opportunity algorithms are sensitive to direct strike, ECM, ARM, and chaff support as well as limited maneuvers of the strike aircraft. Engagement outcomes are sensitive to strike tactics, maneuver, and ECM versus terminal threat radars. Outcomes are assessed by calculating engagement conditions and obtaining lethality values by interpolation of look-up table values.

b. Strike aircraft are simulated with five-degrees-of-freedom utilizing approximations for pitch, bank angle, and climb/descent rates. Matrix inputs are used to describe RCS and jammer antenna patterns. The radar beams and antenna patterns of the air defense systems are modeled in equivalent detail. Each radar can be simulated as part of a detailed, explicit model of the SAM or AAA command and control system or it can be simulated as being autonomous from any centralized control. In order to facilitate validation, TADBM is being developed so that its ECM and lethality calculations can be calibrated with the Air Force Electronic Warfare Evaluation Simulator (AF-EWES). AF-EWES is a hardware simulator that operates at real radar frequencies with manned operators. Penetrating aircraft and portions of the environment are digitally simulated, whereas either actual or digitally simulated jammer equipment can be simulated.

3. RBC CAPABILITIES

a. TADBM provides a highly detailed simulation of multiple RF jammers versus netted, multiple RF sensors. It calculates either S/N or J/S levels as a function of the jamming environment and compares them to detection thresholds. Both S/N and J/S thresholds can be represented by normal distributions where a Monte Carlo algorithm declares a radar detection. S/N thresholds are also used to trigger automatic repeater jammers and to activate radar homing and warning (RHAW) systems. Moreover, several time delays within the SAM/AAA radar network are a function of J/S levels.

b. The SAM/AAA network simulates explicit tracking of threat aircraft using a weighted algorithm and dynamically changes modes of control from centralized, to semi-autonomous, to fully autonomous. Also, the network model contains algorithms to model radar emission control using (1) higher echelon sensor cueing of up to four lower echelons of sensors as to when they should

radiate based on an area or sector of responsibility controlled via inputs and (2) input on/off times to blink the radar while it is activated as an additional ARM countermeasure technique. These algorithms interact with SAM/AAA target assignment routines and ARM algorithms. TADBM simulates terrain masking via site masking table inputs for 36 azimuth angles and one range value. Finally, it contains an area chaff simulation that interacts with RF sensor detection algorithms.

4. MODEL/RBC LIMITATIONS

Since TADBM was designed to evaluate RF sensor systems, it doesn't simulate visual, EO, IR, or optical detection/tracking systems. Nor does it simulate weather effects versus any types of systems. Due to these considerations and insufficient detail in the terrain masking/terrain flight following algorithms, TADBM is inadequate for estimating attrition for slow and low flying aircraft, particularly versus IR-or visually-directed fire control systems. Finally, TADBM doesn't explicitly simulate countermeasures versus RF communications links.

5. INPUTS AND SOURCES

DATA INPUT	SOURCE
Offensive weapon lethality	AF/ADTC
Defensive weapon lethality	AF-EWES, other models
A/C performance data	Dash 1, SPO, Test rpts
ECM equipment parameters	ASD, AFEWC, Tech rpts
SAM/AAA system parameters	DIA/FTD
Target array (scenario)	SCORES
SAM/AAA C^2 parameters	AF/IN, AF-EWES
Jammer antenna patterns	RADC, test rpts
ARM parameters	SPO, Test rpts, Tech rpts
Air defense doctrine	AF/IN

6. REQUIREMENTS

DATA REQUIREMENTS	AVAILABILITY/INTEGRITY
Chaff effects on threat radars	Unavailable
Defensive weapon lethality	All desirable conditions would be too expensive to generate. Is also difficult to keep current.

In general	Most data is available; the trick is to locate it and convert it to the correct format.

7. MODEL IMPROVEMENTS

TADBM is currently being converted to IBM hardware and no major modifications are planned.

CONTACT: Major Glen Harris AV 682-2676

AGENCY: TFWC/SA, Nellis AFB, NV

STATUS: Operational

COMPUTER: CDC 6400, 6600, IBM 360

LANGUAGE: FORTRAN IV

TARGET ACQUISITION/ARTY FORCE SYSTEM MODEL (TAFSM)

1. PURPOSE

To assist in the analysis of field artillery gun or rocket, sensor, and communications systems to measure system performance and combat effectiveness.

2. DESCRIPTION

TAFSM is a one-sided, stochastic model of a division slice of artillery. The entire BLUE artillery system, including the batteries, sensors, fire direction centers and communications, is modeled. The RED maneuver units are modeled as to movement and casualties. The RED artillery force is modeled in terms of sensors, fire direction centers, and batteries, but in a much less detailed fashion than the BLUE force. BLUE maneuver elements are not modeled at all.

3. RBC CAPABLITIES

RED communications and radar jamming are played explicitly while chaff is a probable add-on later. Rain is represented as it affects BLUE radar sensors. Fog/haze are played as a degradation to the probability of detection. Wind is played implicitly in the smoke representation which is RED artillery-delivered or vehicular screening smoke. Smoke and dust are played explicitly since they affect probability of detection. Cloud cover is presently played for COPPERHEAD only. Light level is played explicitly, and night is played implicitly. Terrain is represented in an implied fashion using probability of line of sight. Counter-countermeasures (CCM) against smoke deployment are played such that the BLUE artillery is equipped with a thermal sight, whereas the platoon FO is not. CCM against communications jamming are as follows: re-transmit message, change links, use frequency hopping, change transmission mode to wire or courier.

4. MODEL LIMITATIONS/RBC GAPS

Currently, the size of the BLUE force is restricted to a division. RED jammer movements are scenario-dependent. Some artillery communications are not modeled, i.e., battery to forward observer. Comment: Study requirements/priorities drive model improvement process.

5. INPUTS AND SOURCES

INPUT	SOURCE
RED movement history	SCORES EUR I Seq 2A
BLUE movement history	SCORES EUR I Seq 2A
Fire direction system timing	USAFAS
Sensor (RED/BLUE) capability	USAFAS

Commo timing, S/N	DT III - TACFIRE testing at WSMR
Commo jamming data	DT III - TACFIRE testing at Huachuca
Radar jamming data	DTII/OTII FIREFINDER (36/37) Testing
Smoke overlays	TRASANA
Dust overlays	TRASANA
Weather scenario	TRASANA (WES)

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Smoke	Insufficient quantity for RED
Dust	Non-existent in useable form
Debris	Non-existent in useable form
Rain	Unvalidated
Jamming	Insufficient quantity

7. MODEL IMPROVEMENTS

Ongoing is the incorporation of a set of enhancements to the communications section, to enable the representation of alternatives in the INTACS study, in addition to three sensors, RPV, REMBASS, and FAALS. Mr. Goldberg, HQ TRADOC, has requested that TAFSM be made a two-sided simulation, which will be a lengthy endeavor.

CONTACT: Mr. John Fitzgerrell AV 258-2763

AGENCY: TRASANA

STATUS: Operational

COMPUTER: UNIVAC 1108

LANGUAGE: FORTRAN IV

8. COMMENTS/RECOMMENDATIONS

As is the case with most models used for specific systems analysis or studies, TAFSM treats realistic battlefield conditions adequately, to satisfy past, present and future study requirements.

TACTICAL AIR-TO-GROUND SYSTEM EFFECTIVENESS MODEL (TAGSEM) II MODEL

1. PURPOSE

To evaluate the relative effectiveness of prospective tactical air-to-ground systems. Model was developed during the Offensive Air Support Mission Analysis (OASMA) and extensively modified during the Defense Suppression Integration (DSI). During both efforts, it was used to compare the effectiveness of systems attacking various target arrays, both alone and in concert with a mixed force of strike and support aircraft.

2. DESCRIPTION

The model is an expected value simulation of the interactions that occur in air-to-ground warfare. Flights of manned aircraft, RPVs and/or stand-off weapons, along with their support aircraft, are engaged against a variety of tactical ground targets and ground-to-air defenses. The model utilizes data derived off-line from scenario descriptions, airframe/engine performance payload capabilities, one-on-one system survivability against AAA and SAMs, navigation and target acquisition capabilities, weapon lethalities, aircraft sortie rates, aircraft damages and down time, and defense ammunition or missile supplies. These are used to evaluate overall system effectiveness. Due to its expected-value nature, the model is fast running, and many system options can be investigated quickly.

3. RBC CAPABILITIES

The effects of most RBCs can be reflected in the model by judicious manipulation of the inputs. Friendly countermeasures may degrade the CEP of enemy SAMs. This would be reflected by a decrease in the probability a defense site would kill an aircraft given an encounter. Weather/obscurants are represented by a decrease in friendly target acquisition capability and in the P_k given an encounter of those defenses that require optical acquisition and/or tracking. The RBC listed in questionnaire can all be addressed through changes to an aircraft's survivability, probability of target acquisition, tactics, and weapon lethality.

4. MODEL LIMITATIONS/RBC GAPS

Command and control is not represented explicitly. There are no RBCs represented explicitly. There is no air-to-air or ground forces played other than RED air defense units. The model is completely "hands off", and only short periods of warfare can be played since the model does not contain the logic to dynamically change tactics/missions.

5. INPUTS AND SOURCES

DATA INPUT	SOURCE
Weapon lethality	Armament Dev. Test Center
A/C survivability by threat type	Internal, (AAA/SAM Models)

A/C target acquisition capability	Internal/Tests/Avionics Lab/Analytical Models
Target array descriptions/scenarios	Scores
A/C damages/kill ratios	Reports from S. E. Asia, Mid-east/internal
A/C sortie rates	AF Log Cen/tests/planning factors
RED AD characteristics	DIA/FTD
RED AD employment doctrine/tactics	DIA/FTD
A/C nav capability/abort rates	ASD/SPO/Internal
Degradation due to jamming	MPACT, AFEWES models/internal

6. REQUIREMENTS

DATA REQUIREMENTS	AVAILABILITY/INTEGRITY
C^3 degradation impact on threat effectiveness (eff)	Not readily available
Threat firing doctrine	Not readily available
Human factors impact on friendly and threat eff	Limited availability

7. MODEL IMPROVEMENTS

Inclusion of air-to-air methodology and threat radar network representation are most prominent improvements planned for model.

CONTACT: Mr. John Kordik Comm (513) 255-6261
AV 785-6261

AGENCY: Aeronautical Systems Division (AFSC) Wright Patterson Air Force Base, OH 45433

STATUS: Operational

COMPUTER: CDC 6600

LANGUAGE: FORTRAN IV

TACTICAL AIR LAND OPERATIONS MODEL (TALON) MODEL

1. PURPOSE

To train corps/division commanders in a simulated combat situation. TALON allows the player to see the battle situation develop on the interactive graphics terminal, thereby simulating the way a commander would see an actual battle situation develop. Through the use of the terminal, TALON provides a degree of realism in a wargaming operation, which is not available in other simulations operating only in batch mode under predetermined gaming parameters.

2. DESCRIPTION

a. TALON is a two-sided, corps-level, stochastic model which simulates BLUE force reconnaissance, RED and BLUE forces ground warfare, BLUE force close air support, and mobile interdiction air strike operations. These simulations are interactive in that the results of one can affect the others. The program operates in three distinct phases: initialization, cyclic simulation, and post-processing. During the first two phases, the game player interacts with the program through a series of questions and responses on a graphics terminal. Upon completion of model play, the post processing phase will provide summary reports of the game. TALON is a completely interactive model in which the player can plan reconnaissance flights to determine enemy location, size, and movement. Based on this information, he can plan/order the tactics for the ground operation and for air strikes in support of the ground operation. If he desires, he can allow TALON to automatically allocate the air strikes.

b. The TALON player can specify the time frequency that he desires for receiving status reports. For follow-on analysis purposes, TALON provides an audit trail of the progress of the war in hard copy from the computer line printer. This printout provides information about user-specified input parameters, reconnaissance recoveries with results of the flights, and a summary of each event of the war in time sequence. Thus, a player has snapshot of the war as it progresses, which he obtains from the terminal, and a complete printout of each event of the war obtained from line printer after the game has ended. With this information, the player is able to conduct a complete review and analysis of his particular study, to determine if the objectives of the study were accomplished.

c. Modules that explicitly represent the command and control function, reconnaissance, air-to-ground and air defense for both RED and BLUE have been incorporated into the model.

3. RBC CAPABILITIES

RBC modeled explicitly include cloud cover and night conditions, as well as implicit representation of RED radar jamming, RED/BLUE commo jamming, and terrain.

4. MODEL LIMITATIONS/RBC GAPS

Model does not play jamming explicitly, nor does it play DF'ing, chaff, ARM or other counter-countermeasures. It does not consider weather or obscurants either.

5. INPUTS AND SOURCES

INPUT	SOURCE
Ground scenario	SCORES
Air/Ground weapons effectiveness	JMEMs
Lanchester attrition coefficients	CACDA
Pd tables based on terrain	ARMY
Movement rates	ARMY
RED AD weapons characteristics	AFIN/FTD
RED radar characteristics	AFIN/FTD
Aircraft characteristics	User
Sensor characteristics	User
Effects of jamming	Zinger Models

6. DATA REQUIREMENTS

Data needed for model input is available and adequate for resolution and level of combat represented.

7. MODEL IMPROVEMENTS

On-going efforts include putting model on VAX 11/780 - Completion date Oct 80. Conversion to SIMSCRIPT II.5 - Completion date Dec 80.

CONTACT: Dr. Richard Luckew AV 682-2676

AGENCY: Studies Analysis and Gaming, Tactical Fighter Weapons Center, Nellis Air Force Base, Nevada

STATUS: Operational - Undergoing modification

COMPUTER: CDC Cyber 74

LANGUAGE: FORTRAN IV

8. COMMENTS/RECOMMENDATIONS

If model can play cloud cover and night operations through a degradation of probability of detection and/or movement rate, it should be relatively simple to represent weather and obscurants as they affect the very same parameters, P_d and movement rate. The impact of these conditions with the resolution of the model being at company level could be measured and should be used.

TARGET ACQUISITION MODEL (TAM) MODEL

1. PURPOSE

TAM simulates certain aerial and ground-based systems in order to measure the relative intelligence gathering capability of sensor systems alternatives. It is used in support of the Standoff Target Acquisition System (SOTAS) and Remotely Piloted Vehicle (RPV) COEAs.

2. DESCRIPTION

TAM is a fully computerized, Monte Carlo, one-sided, division-level, target acquisition model. It is composed of a driver, eight sensor subroutines and several auxiliary sensor subroutines. The driver reads the RED target information, sensor performance and employment information, computes the RED target movement history from the start to final target positions, and calls the sensor subroutines. The sensor subroutines simulate the detection/acquisition capability of the following sensor systems: BSTAR, TPS-58, OV-1D SLAR, TPQ-36, TPQ-37, TNS-10, REMBASS, LRRP, BNOP, COOP, SOTAS, MSQ103, TSQ114, UPD-4 AND UPD-16.

3. RBC CAPABILITIES

Explicit Radar jamming and the effects of precipitation are simulated in TAM for the SOTAS and OV-1D SLAR sensor systems only. Direction finding is played explicitly only for the TSQ114 and MSQ103 systems. RED radios are turned on and off according to their duty cycles. The terrain represented is statistical, employing a line-of-sight algorithm which depends on range.

4. MODEL LIMITATIONS/RBC GAPS

TAM, as employed in the COEAs, required the use of two other models (ALPHA & AFSM) for complete results. No attrition or cueing are represented. Each sensor-target interaction is treated independently. Only clear weather and a benign environment are played except for SOTAS and OV-ID SLAR.

5. INPUTS AND SOURCES

INPUT	SOURCE:
Sequence 2A target arrays	USAFAS
sensor detection and acquisition probabilities	Provided by Dr. Brennan of Systems Development Corp and CPT Kilacky of the Intelligence School
DF data and RED radio duty cycles	Provided by TRASANA

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Data to reflect the effects of rain and jamming	Non-existent for 13 of the sensor systems simulated in TAM.

7. MODEL IMPROVEMENTS

No improvements planned at present

CONTACT: Mr. Leo Jacques AV 258-3614/Mr. Bill Millspaugh AV 639-5707

AGENCY: TRASANA/USAFAS

STATUS: Operational

COMPUTER: UNIVAC 1108/CDC 6400

LANGUAGE: FORTRAN V/FORTRAN IV

TACTICAL COMBINED FORCES MODEL (TCF) MODEL

1. PURPOSE

To examine the impact of various TAC Air resource allocation strategies on the outcome of the ground battle and the impact of additional numbers of equipment or the introduction of new systems into the force.

2. DESCRIPTION

a. An evolutionary variant of LULEGIAN I, the TCF is a two-sided, theater-level, tactical, combat model. It is a dynamic model of theater warfare that involves conventional weapons, with particular emphasis on modeling conflict in the European theater. The computer program models the interaction of opposing armies and the ground battle with resolution to battalion level. It is a deterministic, force-on-force model that comprises four main submodels: (a) The "executive program" which controls the input/output of data and the calling sequence to the other routines and controls the optimization switches (b) the "ground model" which simulates the interactions between opposing ground forces and computes a resulting FEBA movement (c) the "TAC AIR" model which addresses all the interactions between the tactical aircraft and opposing forces (this includes air-to-air, air-to-ground, and ground-to-air) and (d) the logistics model which crudely models the flow of supplies and additional forces into the theater and from the "front-level" supply depots to the units fighting along the FEBA.

b. It should be noted that this model is a deterministic and aggregate model that is designed to be useful for analyses of force alternatives. Although combat outcomes are computed, the model should not be considered as a tool for obtaining precise predictions of the outcome of any specific conflict. Rather, the outcomes obtained from using the model should be regarded as "ballpark" estimates that provide a consistent basis for comparing the various force alternatives.

3. RBC CAPABILITIES

All aspects of battle are treated in the same amount of detail for both sides. In general, most RBC conditions can be reflected by generating inputs that reflect a general state, usually an average level, for those conditions. This state is not modified during the conflict. Some of the parameters represented in the model are dynamic, but are not impacted by nor do they impact all other cause and effect parameters. For example, aggregated terrain segments (including obstacle segments) affect ground force sector movement rates, but do not impact target acquisition parameters. Radar jamming done from stand-off or self-screening Jammers is reflected by degradation values applied to the probability of kill of the aircraft by the defense site.

4. LIMITATIONS AND SOLUTIONS

MODEL LIMITATIONS	POSSIBLE SOLUTIONS
Resolution of	Implied via sys. capability inputs
- day/night	Increment states:
- weather	Worst/avg/best case
- time	Increment states
Aggregated AAA and SAM - defense suppression	Currently redefining SAM/AAA structure to reflect the variety of air defense types and their employments.
- dilution and saturation	
Targeting runways	Modify model to affect sortie rate
Defense supression	Modify model
Resolution of analysis	Use Complementary off-line analysis

5. INPUTS AND SOURCES

INPUT	SOURCE
Air Force force levels	Air Staff - Pentagon
Army force level	SCORES/CAA/NATO
Air Force effectiveness	In-house, AF Arm. Dev. Test Ctr
Army effectiveness	AMSAA
Logistics	FM, TRADOC
Scenario description	SCORES, User, TFWC, AFSA
Attrition levels	In-house, TFWC, AFSA, AFEWES
Aircraft effectiveness	Sys Prog. Office
Movement rates	In-house, studies
Air-to-air attrition	Studies

6. MODEL IMPROVEMENTS

Correct or improve items (solutions) listed in previous page.

CONTACT: John Kordik AV 785-6261, Comm 513-255-6261

AGENCY: Deputy for Development Planning, Aeronautical Systems Div., Wright Patterson AFB, OH 45433

STATUS: Operational

COMPUTER: CDC 6600

LANGUAGE: FORTRAN IV

TACTICAL ENVIRONMENTAL INPUT ANALYSIS SYSTEM (TENIAS) MODEL

1. PURPOSE

Model was designed to evaluate the unintentional degradation of friendly C-E equipment when jamming operations are conducted against enemy systems.

2. DESCRIPTION

TENIAS is an analysis model used for calculating potential interference to one or more receivers in an environment of one or more transmitters. Typical measures of interference are interference-to-noise ratio and signal-to-interference ratio. These analysis systems normally use threshold detection logic to identify potential cases of interference.

3. RBC CAPABILITIES

Explicit representation of RED and BLUE communications and radar jamming. Also uses a smooth earth propagation model. Through appropriate data input, jammers could be RED or BLUE, victims could be RED or BLUE; any deployment could be mapped to appropriate format. Thus, TENIAS could be used to evaluate intentional jamming of RED force, i.e., jamming effectiveness, or vulnerability of BLUE force to RED jamming.

4. MODEL LIMITATIONS/RBC GAPS

Model limitations are as follows:

a. Minimum desired signal levels are assumed at victim receivers rather than calculated.

b. There is no DF nor chaff played in model.

c. There are deficiencies in SCORES/INTACS deployment model which is used as input source for TENIAS.

5. EW DATA INPUT

Target array, netting information, frequency assignments, jammer emission spectra, victim selectivity data, degradation criteria.

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
C-E systems characteristics;	New systems being tested or developed.
C-E performance parameters;	"

7. MODEL IMPROVEMENTS

Deployment does not contain latest equipments, reflect recent reorganizations of Army with resultant changes in O&O concepts, etc.

CONTACT: MAJ H. P. Sanders AV 281-2103

AGENCY: ECAC, Annapolis, MD

STATUS: Operational

COMPUTER: UNIVAC 1100

LANGUAGE: FORTRAN V

WAR EAGLE TRAINING WARGAME

1. PURPOSE

Same as FIRST BATTLE

2. DESCRIPTION

A simulation which comprises two or more FIRST BATTLE division level exercises into a corps level war game, to exercise the corps, COSCOM commanders and staffs in the decision-making process.

3. RBC CAPABILITIES:

Same as FIRST BATTLE

4. MODEL LIMITATIONS/RBC GAPS:

Same as FIRST BATTLE

5. INPUT:

FIRST BATTLE

6. REQUIREMENTS:

FIRST BATTLE

7. MODEL IMPROVEMENTS:

FIRST BATTLE

CONTACT: MAJ Doug Nolen AV 552-3395, 3180

AGENCY: CATRADA

STATUS: Operational

COMPUTER: None

LANGUAGE: N/A

WARRANT MODEL

1. PURPOSE

To measure the military worth of ECCM, SIGSEC, and communications systems.

2. DESCRIPTION

WARRANT is a dynamic, symmetrical, division-level combat model that can play capabilities on either or both sides simultaneously, as applicable with changes in input data. It simulates the following systems: command and control (BLUE and RED), communications (BLUE) and intelligence gathering (RED). Output is in the forms of graphic (CRT) display of battlefield to company resolution; casualties, materiel losses, and ammo expenditure (RED and BLUE forces); message internals and externals, and event summary of the battle.

3. RBC CAPABILITIES

Explicit representation of RED commo jamming and RED DF. It also plays terrain by explicit representation of land form. The kinds of jamming considered are brute force - noise or special input. The jamming employed is determined by "man-in-the-loop", stochastically, and by cueing. Terrain characteristics enter into path loss calculations, The J/S or S/N ratio is computed at victim receiver; if above threshold, transmission is stopped.

4. MODEL LIMITATIONS/RBC GAPS

No radar jamming, chaff or ARM represented. There is no weather or obscurants. It requires CDC 7600 for full implementation; however, it will run on 6600 in reduced capacity. Another limitation is "man-in-the-loop" for intelligence related decisions.

5. INPUTS AND SOURCES

INPUT	SOURCE
Unit deployment	SCORES
Commo	Field test data, laboratory
Threat REC	User Supplied

6. REQUIREMENTS

None identified

7. MODEL IMPROVEMENTS

Improvements Underway

1. Propagation loss measurement
2. Close air support operations
3. Validation

CONTACT: Mr. A. S. Torf (703) 821-5230

AGENCY: BDM Corporation, 7915 Jones Branch Drive, McLean, VA 22102

STATUS: Operational

COMPUTER: CDC 7600/6600

LANGUAGE: FORTRAN

ZAP I MODEL

1. PURPOSE

To evaluate the impact of Soviet EOCM on COPPERHEAD and HELLFIRE weapon systems using a quick and inexpensive wargame simulation.

2. DESCRIPTION

ZAP I is a small unit, Markov chain, force-on-force, combat model. It represents an engagement between a RED force of attack units and a BLUE laser-guided weapon defense consisting of ground laser designators and attack helicopters equipped with HELLFIRE or designators and COPPERHEAD. The model plays RED vehicle fire at the designators or helicopters and BLUE laser-guided weapons fire at the RED vehicles. The target and designator positions are preprocessed to provide the probability of an LOS existing to the target as a function of range. Smoke is represented as total obscuration for a given cloud dimension.

3. RBC CAPABILITIES

Implicit representations of smoke, terrain, vegetation, and commo jamming as time delays, are available in the model. Any condition can be represented if its effect is reduced visibility. Also various EOCM devices are played.

4. MODEL LIMITATIONS/RBC GAPS

Only one type of RED vehicle, i.e., tank or BMP, is played. A total of 14 vehicles and designators are modeled. All vehicle/helicopter maneuvers are preplanned. Terrain is represented stochastically. EOCM is represented as reduction in kill probability.

5. INPUTS AND SOURCES

INPUT	SOURCE
P_{LOS}	Preprocessor Programs
$P_{detection}$	TRADOC/DARCOM elements
P_{firing}	TRADOC/DARCOM elements
P_{hit}	TRADOC/DARCOM elements
P_{kill}	TRADOC/DARCOM elements

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Data preferred as a density function although probabilities could be used.	Insufficient quantity of data collected/assembled in field testing.

7. MODEL IMPROVEMENTS

May be extended to include two RED vehicle types plus both laser-guided weapons simultaneously.

CONTACT: O. A. Davenport AV 258-3983

AGENCY: OMEW WSMR NM

STATUS: Operational

COMPUTER: Amdahl 470-V5, IBM 360/65

LANGUAGE: FORTRAN

8. COMMENTS/RECOMMENDATIONS

Model developed by and run at New Mexico State University, Las Cruces, New Mexico 88003, Dr. Paul Finch.

ZAP II MODEL

1. PURPOSE

To evaluate the impact of EOCM on the HELLFIRE weapon system using a simulation which represents EOCM device location with respect to target location. Simulation is efficient, easy to apply and inexpensive to run.

2. DESCRIPTION

ZAP II is a small unit simulation representing an engagement between a RED force of attack units and a BLUE force of attack helicopters equipped with HELLFIRE and aided by ground laser designators. The model plays RED vehicle fire on ground laser designators and attack helicopters, and attack helicopter laser-guided missile fire on the attack units. The terrain and ground laser designator positions are preprocessed to provide LOS attack route blocks for each attack unit. Smoke is represented as total obscuration for a given cloud dimension. Other CM can be played by knowing their impact on acquisition time distribution, or probabilities of hit.

3. RBC CAPABILITIES

Implicit representations of smoke, terrain, and vegetation are available in model. Commo jamming is represented as time delays.

4. MODEL LIMITATIONS/RBC GAPS

CM are represented by their effect on LOS, acquisition times, hit probabilities, etc., and not as individual devices. All maneuver is pre-planned and not simulated by the model. Preprocessor calculates engagement opportunities depending on terrain, vegetation, attack routes and rates-of-advance instead of handling in program.

5. INPUTS AND SOURCES

INPUT	SOURCE
Projectile speed	TRADOC/DARCOM elements
Hit probabilities	TRADOC/DARCOM elements
Acquisition times	TRADOC/DARCOM elements
Time delays due to jam	TRADOC/DARCOM elements
Kill probabilities	TRADOC/DARCOM elements

6. REQUIREMENTS

REQUIREMENTS	AVAILABILITY/INTEGRITY
Test data for repeaters/jammers	Non-existent in fieldable countermeasures

7. MODEL IMPROVEMENTS

Autonomous designation by helicopters, addition of the COPPERHEAD weapon system.

CONTACT: O. A. Davenport AV 258-3983

AGENCY: OMEW, WSMR NM

STATUS: Operational

COMPUTER: Amdahl 470-V5, IBM 360/65

LANGUAGE: SIMSCRIPT II.5

COMMENTS/RECOMMENDATIONS: Model developed by and run at New Mexico State University, Las Cruces, NM 88003, Dr. Paul Finch.

COMBINED ARMS AND SUPPORT TASK FORCE EVALUATION MODEL (CASTFOREM)

1. PURPOSE

CASTFOREM is to provide the lowest level component of a new family of models which will be the production tools for supporting Army studies. The hierarchy of (three - CASTFOREM, CORDIVEM, FORCEM) new combined arms and support simulation models will provide force-on-force results for simulated combat at small unit through major organization levels. The purpose of this model is to generate battle outcome results for friendly and enemy forces, and to support studies of certain item systems as normally organic to major organizations.

2. DESCRIPTION

The CASTFOREM component is conceived to be task force level in scope and resolved at item system level. CASTFOREM will represent the detailed operations of the combined arms and support task force. It will be used to determine the effectiveness of units and item systems, and to estimate the level of personnel and equipment attrition and resource consumption in task force operations. The model is a stochastic, two-sided simulation of ground combat involving BLUE units no larger than a reinforced battalion and RED units no larger than a reinforced regiment. Certain results will be provided as model outputs, according to the needs of particular studies, and will be fed to the next higher-level model, CORDIVEM. The battlefield functions that need to be represented in each member of the family of combined arms and support models have been identified as: close combat, fire support, air defense, combat support, combat services support, control, command and communications, and surveillance, intelligence and fusion. The model's development process has been divided into three phases. IOC for first phase is Oct 80, second phase Mar 81, and final phase Oct 81.

3. RBC CAPABILITIES

The scope of the requirements to represent the battlefield situation in FORCEM, CORDIVEM, and CASTFOREM is the same, but the spatial and temporal resolution will progressively increase, respectively. The battlefield situation encompasses all the conditions of the battlefield, i.e., terrain, weather, obscurants, contaminants, and electronic warfare which pervades each of the mission areas. Terrain primarily affects intervisibility, mobility, and communications. Elevation and feature data will be specified in DMA tapes according to a horizontal square grid. Natural environmental elements to be considered are: visibility range, day/night, ceiling, cloud cover, rain intensity, fog, snow intensity, absolute humidity, and wind speed and direction. The effects of smoke and dust, dynamically generated in the simulation will be assessed, as well as the effects of nuclear and chemical operations. Finally, the effects of electronic warfare on combat units, C^3, combat support and combat services support elements will be assessed. This will include effects of electronic countermeasures, electronic warfare support measures, and electronic counter-countermeasures.

4. MODEL LIMITATIONS/RBC GAPS

None identified - model in design/developmental stage.

5. INPUTS

TBD

6. REQUIREMENTS

TBD

7. MODEL IMPROVEMENTS

None identified.

CONTACT: Mr. Doug Mackey, AV 258-2902

AGENCY: TRASANA
White Sands Missile Range, NM

STATUS: The majority of the model's design specifications has been written. The coding of these is ongoing at TRASANA.

COMPUTER: UNIVAC 1100/82 and DEC VAX 11/780

LANGUAGE: SIMSCRIPT II.5

CORPS AND DIVISION EVALUATION MODEL (CORDIVEM)

1. PURPOSE

CORDIVEM is to provide a component of a new family of models which will be the production tools for supporting Army studies. The hierarchy of (three - CASTFOREM, CORDIVEM, FORCEM) new combined arms and support simulation models will provide force-on-force results, including attrition rates and resource consumptions, for simulated combat at small unit through major organization levels. The purpose of the model is to support design and structure tradeoff analyses of Army organizations, such as brigade, division and corps; and to support studies of certain item systems as normally are organic to major organizations.

2. DESCRIPTION

The CORDIVEM component is conceived to be corps or division level in scope and resolved at task force level (brigade, battalion, or company team, depending on terrain and combat circumstances). The model takes as input, (from FORCEM) descriptions of the battlefield situation (scenario) for the corps (army)/division and, (from CASTFOREM) battle outcomes for task forces. Similarly, it will output corps (army)/division battle outcomes to FORCEM and provide scenario descriptive data for task forces to CASTFOREM. The battlefield functions that need to be represented (not necessarily explicitly) in each member of the family of combined arms and support models have been identified as: close combat, fire support, air defense, combat support, combat services support, control, command and communications, and surveillance, intelligence and fusion.

3. RBC CAPABILITIES

The scope of the requirements to represent the battlefield situation in FORCEM, CORDIVEM, and CASTFOREM is the same, but the spatial and temporal resolution will progressively increase, respectively. The battlefield situation encompasses all the conditions of the battlefield, i.e., terrain, weather, obscurants, contaminants, and electronic warfare which pervades each of the mission areas. Terrain primarily affects intervisibility, mobility, and communications. Elevation and feature data will be specified in DMA tapes according to a horizontal square grid. Natural environmental elements to be considered are: visibility range, day/night, ceiling, cloud cover, rain intensity, fog, snow intensity, absolute humidity, and wind speed and direction. The effects of smoke and dust, dynamically generated in the simulation will be assessed, as well as the effects of nuclear and chemical operations. Finally, the effects of electronic warfare on combat units, C^3, combat support and combat services support elements will be assessed. This will include effects of electronic countermeasures, electronic warfare support measures, and electronic counter-countermeasures.

4. LIMITATIONS/RBC GAPS

[illegible] model in design/developmental stage.

5. INPUTS

TBD

6. REQUIREMENTS

TBD

7. MODEL IMPROVEMENTS

None identified.

CONTACT: Mr. Bob Davison, AV 552-5176/2589

AGENCY: CASAA
Ft Leavenworth, KS

STATUS: Developmental/design stage

COMPUTER: VAX 11/780, UNIVAC 1100/82

LANGUAGE: FORTRAN

FORCE EVALUATION MODEL (FORCEM)

1. PURPOSE

FORCEM is to provide a component of a new family of models which will be the production tools for supporting Army studies. The hierarchy of (three - CASTFOREM, CORDIVEM, FORCEM) new combined arms and support simulation models will provide force-on-force results, including attrition rates and resource consumptions, for simulated combat at small unit through major organization levels. The purpose of this model is to help resolve force level issues such as: alternatives for improvement of the readiness of current forces, design of the best force structure within given constraints, and determination of theater resource requirements for sustained combat periods.

2. DESCRIPTION

The FORCEM component is conceived to be theater-wide in scope, campaign long in duration, and resolved at division level. The model will operate essentially as a manager of theater assets to accomplish established military objectives. The assets include the ground combat forces, the tactical air forces, non-divisional combat support, the service support structure, and all replacement and resupply resources, both pre-positioned and those coming into the theater. The results of this management are assignment of locations and missions to subordinate units and allocation of support resources to reinforce these assignments. The above management by both sides will generate combat situations described at division level by a number of parameters representing certain decisions on the use of support resources, the environmental conditions on the battlefield, the terrain, and descriptors of the participating forces. Combat results will be determined for each situation through algorithms to be calibrated from runs by the CORDIVEM model. These results will be considered by the FORCEM management decision process in subsequent decision actions. Certain results will also be provided as model outputs according to the needs of particular studies. The battlefield functions that need to be represented (not necessarily explicitly) in each member of the family of combined arms and support models have been identified as: close combat, fire support, air defense, combat support, combat services support, control, command and communications, and surveillance, intelligence and fusion.

3. RBC CAPABILITIES

The scope of the requirements to represent the battlefield situation in FORCEM, CORDIVEM, and CASTFOREM is the same, but the spatial and temporal resolution will progressively increase, respectively. The battlefield situation encompasses all the conditions of the battlefield, i.e., terrain, weather, obscurants, contaminants, and electronic warfare which pervades each of the mission areas. Terrain primarily affects intervisibility, mobility, and communications. Elevation and feature data will be specified in DMA tapes according to a horizontal square grid. Natural environmental elements to be considered are: visibility range, day/night, ceiling, cloud cover, rain intensity, fog, snow intensity, absolute humidity, and wind speed and direction. The effects of smoke and dust, dynamically generated in the simulation will be assessed, as well as the effects of nuclear and chemical

operations. Finally, the effects of electronic warfare on combat units, C^3, combat support and combat services support elements will be assessed. This will include effects of electronic countermeasures, electronic warfare support measures, and electronic counter-countermeasures.

4. MODEL LIMITATIONS/RBC GAPS

None identified - model in design/developmental stage.

5. INPUTS

TBD

6. REQUIREMENTS

TBD

7. MODEL IMPROVEMENTS

None identified.

CONTACT: Mr. Phil Louer, AV 295-1693/1692

AGENCY: Concepts Analysis Agency
Bethesda, MD

STATUS: Developmental/design stage

COMPUTER: UNIVAC 1100/82

LANGUAGE: FORTRAN V

APPENDIX C

DEFINITIONS

Aggregated Model - A model in which many detailed elements of a process are combined into and examined as a large entity. Thus, a model which treats a division as an entity in theater-level combat, has aggregated platoons, scout patrols, fire support batteries, companies, battalions, and brigades into the entity called a division and is therefore an aggregated model.

Analytical Model - A model that comprises sets of mathematical equations as models of all the basic events and activities in the process being described and an overall assumed mathematical structure of the process into which the event or activity descriptions are integrated.

Assessment - A model activity which determines the attrition of men or materiel, the degradation of unit capabilities, or movement.

Barrage Jamming - Simultaneous electronic jamming over a broad band of frequencies.

Chaff - Radar confusion reflectors that consist of thin, narrow, metallic strips of various lengths and frequency responses, used to reflect echoes for confusion purposes. To be most effective, the strips are cut to a half wavelength of the desired radar frequency.

Combat Model - Model used to describe the basic combat processes of firepower, mobility, intelligence, logistics and C^2 in order to estimate the outputs of battles and wars.

Communications Intelligence (COMINT) - Technical and intelligence information derived from foreign communications by other than the intended recipients.

Communications Security (COMSEC) - the protection resulting from all measures designed to deny to unauthorized persons information of value that might be derived from the possession and study of telecommunications, or to mislead unauthorized persons in their interpretations of the results of such study. COMSEC includes cryptosecurity, physical security, and transmission security.

Computer Assisted Wargame - A wargame in which a number of the assessment routines are automated.

Counter-countermeasures - US (BLUE) devices, techniques, or tactics employed to prevent the reduction of or to retain operational effectiveness of US materiel despite CM activity by the enemy.

Countermeasures - Enemy (RED) devices (e.g., target acquistion sensors, weapon systems, etc.) techniques, or tactics that have as their objective the reduction of operational effectiveness of US materiel.

Data - usually considered as input to a model. These may be experimental facts (the classical definition) or subjective judgements.

Deception - operation undertaken to support tactical and strategic plans and orders to deny enemy surveillance true information while providing the enemy false information to achieve surprise.

Deterministic Model - A model which contains only deterministic events and variables so that the output of the model is uniquely determined by the input.

Electromagnetic - pertaining to the combined electric and magnetic fields associated with radiation or with movements of charged particles.

Electronic Counter-countermeasures (ECCM) - That major subdivision of electronic warfare involving actions (by BLUE) taken to insure continued effective use of communications, surveillance and acquisition devices despite actions (countermeasures) by the enemy (RED) to deny that use.

Electronic Deception - The deliberate radiation, reradiation, alteration, absorption, or reflection of electromagnetic radiations in a manner intended to mislead an enemy in the interpretation of data received by his electronic equipment or to present false indications to electronic systems.

Electronic Intelligence (ELINT) - The intelligence information product of activities engaged in the collection and processing, for subsequent intelligence purposes of foreign, noncommunications, electromagnetic radiations emanating from other than nuclear detonations and radioactive sources.

Electronic Warfare (EW) - That division of the military use of electronics involving actions taken to prevent or reduce an enemy's effective use of radiated electromagnetic energy, and actions taken to insure our own effective use of radiated electromagnetic energy.

Electronic Warfare Support Measures (ESM) - That division of EW involving actions taken to search for, intercept, locate, and immediately identify radiated electromagnetic energy, for the purpose of immediate threat recognition. Thus, ESM provides a source of EW information required to conduct ECM, ECCM, threat detection, warning, avoidance, target acquistion and homing.

Electro-Optic (EO) - Term used to describe the technology achieved through the union of optics and electronics. As presently applied, the term includes lasers, photometry (light intensity measurements), infrared and various other types of visible and infrared systems, i.e., low light level television (LLTV), optical contrast sensors, and signal processing devices.

Emitter - Term used to describe any device that radiates electromagnetic energy.

Event - That which happens or occurs at an instant in time and has associated with it a change in state, i.e., the firing of a rocket, the receipt of intelligence information, the end of a battle.

Expected Value Model - A deterministic model in which the inputs are expected values of probabilistic variables.

Force Employment Study - A study to determine how forces are to be used. At the theater level this is normally the study of the allocation of forces within the theater, while within a division, it is a study of how forces should be maneuvered.

Force Level Study - A study to determine the total number of divisions required for a particular mix of division types.

Force Ratio - The ratio of the strength of one or two opposing forces to the other, where strength is indicated by measures such as survivors, fire-power score, etc.

Force Structure (Mix) Study - A study to determine the organization and numbers of different types of units in a combat organization.

Free Wargame - A game in which the controller freely applies his own judgement and military experience or insight to make assessments.

Game - A model of a situation of competition or conflict in which opposing players decide which courses of action to follow on the basis of their knowledge about their own situation and intentions and on their (usually incomplete) information about their opponent's courses of action.

Hierarchy of Models - A set of models in which the outputs of one element in the set become inputs to another element in the set.

Imitative Electronic Deception - The intrusion on the enemy's channels and the introduction of matter in imitation of his own electromagnetic radiation for the purpose of deceiving or confusing him.

Interception (EW Sense) - The act of listening in on and/or recording signals intended for another party for the purpose of obtaining intelligence.

Interference - Any electrical disturbance from a source external to the equipment that causes undesirable responses in electronic circuits.

Jamming - The deliberate radiation, reradiation, or reflection of electromagnetic energy with the objective of impairing the use of electronic devices, equipment, or systems being used by the enemy.

Jamming-to-Signal Ratio - The ratio of the jamming signal power to the target signal power measured at the target receiver antenna.

Level of Resolution - The level of detail or smallest unit considered as the basic element in a combat model, as well as the smallest dimension of time and space employed.

Manipulative Electronic Deception - The use of friendly electromagnetic radiations in such a manner as to falsify the information that a foreign nation can obtain from analysis of these electromagnetic radiations.

Manual Wargame - A wargame in which all decisions, assessments and bookkeeping functions are performed manually.

Meaconing - The deliberate effort to mislead pilots who depend on navigational aids for geographic orientation, by blotting out the desired signal and establishing a false beacon from another location.

Model - An abstract representation of reality which is used for the purpose of prediction and to develop understanding about the real-world process. A computerized model is a computer program or series of programs designed to simulate the logic of actions or interactions of an environment or a context and provide the results to player personnel for subsequent analysis. A model can also be defined as a document or program containing all rules, methodology, techniques, procedures and logic to simulate or approximate reality.

Model Input - The condition and/or numerical values of model parameters used to quantitatively solve the problem being modeled, thus generating model outputs.

Model Output - The numerical values of the result of the activity being modeled, i.e. values of the dependent variable. In essence, model output may be a complete description of the activity described by the model.

Monte Carlo Sampling Procedures - A statistical procedure using a chance device (random number generator, dice, etc.) to determine the occurrence of probabilistic events or values of probabilistic variables.

Monte Carlo Solution Procedure - A means of solving stochastic models through the use of Monte Carlo sampling procedures. The models are solved by sampling all input distributions in proper sequence to produce a single output.

Noise - Interference whose energy is distributed across a wide band of frequencies. It is received along with desired signals or generated within the equipment receiving the signals. It may be caused by natural radiation or man-made equipment.

Outcome - The result of the assessment of a particular event, engagement or battle.

Parameter - A constant in a particular play of the model, e.g., average time to detect a target and probability that a projectile hits the target. Values for parameters may be changed between runs.

Player-Assisted Simulation (User-Assisted) - A simulation model in which most of the activites are automated (computerized). The model is designed to allow player (user) inputs during play, with or without game controllers.

Probabilistic (Random) Event - A model event which is considered to depend on chance elements.

Probabilistic (Random) Model - A model which contains at least one probabilistic event or variable so that the output of the model is not uniquely determined by the input.

Probabilistic (Random) Variable - A model variable which is considered to depend on chance elements.

Probability - A measure of the degree of uncertainty associated with the occurrence of an event.

Pulse Repetition Frequency (PRF) - In radar, the number of pulses that occur each second. Should not be confused with transmission frequency which is determined by the rate at which cycles are repeated within the transmitted pulse.

Radar - Application of radio principles to detect the presence of an object, its character, direction and distance. The word is derived from the term radio detection and ranging.

Radiate - to send out energy, such as radio frequency waves, into space.

Radio - Communication by electromagnetic waves transmitted through space.

Radio Direction Finding - The process of determining the location of an electronic emitter through the intersection of azimuths or bearings obtained from three or more locations.

Radio Frequency - A frequency in which radio transmission is possible. The useful range is approximately from 10kHz to 100,000 MHz.

Realistic Battlefield Conditions (RBCs) - are defined as EW, smoke, aerosols, rain, fog, haze, dust, etc.

Repeater Jammer - A transmitting device that is triggered by the radar transmitter signal and responds with one or more pulses of energy at or near the radar frequency.

Replication - The process of repeating the sampling procedure in the Monte Carlo solution of a stochastic model for a fixed set of input parameter values.

Resolution - The level of detail represented in the model. High resolution refers to greater detail, low to lesser detail.

Scenario - A description of the setting in which the military, political, economic, and social environment is established and the physical geography is set forth in which to apply a combat model in a study.

Sensitivity Analysis - A procedure in which marginal changes in input parameter values or assumptions are made in order to ascertain the effect these changes have on model output.

Signal Intelligence (SIGINT) - A generic term that includes both communications and electronic intelligence.

Signal Security (SIGSEC) - A generic term that includes both communications and electronic security.

Signal-to-Noise Ratio (S/N) - The ratio of the amplitude of the desired signal to the amplitude of the noise signal at a given point in time.

Simulation - An analytical technique which involves the use of mathematical and logical models to represent the study and behavior of real world or hypothetical events, processes, or systems over an extended period of time.

Soviet Radio Electronic Combat (REC) The total integration of RED electronic warfare (EW) and physical destruction resources to deny the BLUE use of his electronic control systems and to protect friendly RED control systems from disruption by the enemy.

Spot Jamming - The jamming of a specific channel or frequency.

State - Current value of all the friendly systems, threat systems, and environment descriptors. For example, the number of surviving units by type, number detected, line-of-sight statuses, amount of ammunition remaining, location of units, movement status, etc.

Stochastic - Probabilistic.

Susceptibility - The degree to which a device, equipment or weapon system is open to effective attack because of one or more inherent weaknesses.

Trade-Off Analysis - Comparative analysis of different alternatives usually based on equal cost constraints.

Transmission Security - That component of communications security that results from all measures designed to protect transmissions from unauthorized interception, traffic analysis and imitative deception.

Transmitter - Term applied to any of the electrical equipment used for generating, amplifying, modulating, and radiating the modulated RF carrier into space.

Variable - The designation given to a quantity which may vary throughout the course of a single model evaluation, e.g., the time required to detect a target is a variable which may be viewed as either a deterministic or probabilistic variable.

Vulnerability - The characteristic of a system that causes it to suffer a definite degradation as a result of having been subjected o a certain level of effects in an unnatural (man-made) environment.

Wargame - The Department of Defense defines this as a simulation of a military operation involving two or more opposing forces and using rules, data and procedures designed to depict an actual or assumed real-life situation. It is a technique used to address and analyze problems involving military organization planning, tactics and strategies. There are three types of wargames: the training game, designed to provide participants with decision making opportunities similar to those that may be experienced in combat; the operational game, used to test operational plans; and the research game, usually designed to study tactical or strategic problems in a future time frame. A wargame can be manual, player-assisted, computer-assisted, or wholly computerized.

APPENDIX D

GLOSSARY

-A-

AAA	Antiaircraft artillery
Acad of Health Sc	Academy of Health Science
ACSI	Assistant Chief of Staff, Intelligence
AD	Air defense
ADA	Air defense artillery
ADMINCEN	Administration Center
ADTC	Armament Development Test Center
AFCAS	Air Force Close Air Support
AFEWES	Air Force EW Evaluation Simulator
AFIN	Air Force Intelligence
AFSA	Air Force Studies and Analysis
AFSC	Air Force Systems Command
AFTEC	Air Force Test and Evaluation Command
AGGR	Aggregated
AI	Airborne interceptor
AIRDEFSCH	Air Defense School
AMSAA	Army Materiel Systems Analysis Activity
ARI	Army Research Institute
ARM	Antiradiation missile
ARMORSCH	Armor School
ARP	Antiradiation projectile
ARRADCOM	Armament R&D Command
ARTY	Artillery
ASD	Aeronautical Systems Division
AVIATIONSCH	Aviation School
AVRADCOM	Aviation R&D Command

AWACS	Airborne warning and control systems
A/C	Aircraft

-B-

BDM	Braddock, Dunn and McDonald, Inc.
BRL	Ballistic Research Laboratory
BSI	Battlefield Systems Integration/HQ, DARCOM

-C-

CAA	Concepts Analysis Agency
CAC	Combined Arms Center
CACDA	Combined Arms Combat Dev. Activity
CAS	Close air support
CATRADA	Combined Arms Training Dev. Activity
CAV	Cavalry
CBR	Chemical, biological, radiological
CBT SPT	Combat Support
CBT SERV SPT	Combat Services Support
CCM	Counter-countermeasures
CDC	Combat Development Command
CDC	Control Data Corporation
CDEC	Combat Dev. Experimentation Center
CEMCOM	Commo & Electronic Materiel Readiness Command
CEP	Circular error probable
CGSC	Command & General Staff College
CM	Countermeasures
COMINT	Communications intelligence
COMJAM	Communications jamming

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DTIC

COMSEC	Communications security
COMMO	Communications
CORADCOM	Communications R&D Command
CP	Command post
CRT	Cathode ray tube
CSTA	Combat Surveillance and Target Acquisition
C^2	Command and control
C^3	Communication, command & control

-D-

DEPOT SYS COM	Depot System Command
DF	Direction finding
DIA	Defense Intelligence Agency
DMA	Defense Mapping Agency

-E-

EAI	Electronic Associates, Inc.
ECAC	Electronic Compatibility Analysis Center
ECCM	Electronic counter-countermeasures
ECM	Electronic countermeasures
EEP	Elliptical error probable
ELINT	Electronic intelligence
ENGRCEN	Engineer Center
ERADCOM	Electronics R&D Command
ERP	Effective radiated power
EPG	Electronic Proving Ground
ESJ	Escort jammer
EW	Electronic warfare
EW	Early warning

EWC	Electronic Warfare Center (AF, San Antonio)
EWL	Electronic Warfare Lab (Army, Ft Monmouth)

-F-

FDC	Fire direction center
FIST	Fire support team
FLIR	Forward looking infrared
FM	Field manual
FM	Frequency modulation
FO	Forward observer
FSTC	Foreign Science & Technology Ctr (Army)
FTD	Foreign Technology Division (AF)

-G-

GCI	Ground controlled intercept
GRC	General Research Corp.

-H-

HDL	Harry Diamond Lab
HE	High explosive

-I-

INF	Infantry
INFSCH	Infantry School
INSCOM	Intelligence Security Command
INTELCEN	Intelligence Center
IRCM	Infrared countermeasures

-J-

JMEMs	Joint Munitions Effectiveness Manuals
J/S	Jammer power-to-signal power ratio

-L-

LOGCEN	Logistics Center
LOS	Line-of-sight

-M-

MECH INF	Mechanized infantry
MERADCOM	Mobility Equip R&D Command
MI	Missile interceptor
MICOM	Missile Command
MSL/MUNCEN	Missiles/Munitions Center
MTI	Moving target indicator

-N-

NARADCOM	Natick R&D Command
NAV	Navigation
NV&EOL	Night Vision & Electro-Optical Lab

-O-

OMEW	Office of Missile Electronic Warfare
OR	Operations research
ORD/CMLCEN	Ordnance/Chemical Center

-P-

P&A	Plans and Analysis
P_D	Probability of detection

P_H	Probability of hit
P_J	Probability of jamming
P_K	Probability of kill
$P_{K/H}$	Probability of kill given a hit
P_S	Probability of survival
P_{TA}	Probability of target acquisition
POL	Petroleum, oil, lubricants
PSK	Phase-shift key

-Q-

QPSK	Quad-phase shift key

-R-

R&D	Research & Development
RADJAM	Radar jamming
RBC	Realistic battlefield conditions
REC	Radio electronic Combat (Soviet)
RECON	Reconnaissance
RPV	Remotely Piloted Vehicle

-S-

SAM	Surface-to-air missile
SATCOM	Satellite Communications Agency
SCORES	Scenario-Oriented Recurring Evaluation System
SDC	Systems Development Corporation
SIGCEN	Signal Center
SIGINT	Signals intelligence
SIGSEC	Signals security

SOJ	Standoff jammer
SPO	Systems Program Office (Af, = Army's PMO)
SSI	Strategic Studies Institute
SSJ	Self-screening jammer
SSM	Surface-to-surface missile
SWL	Signals Warfare Lab
S/J	Signal power to jammer power ratio
S/N	Signal-to-noise ratio

-T-

TAC	Tactical
TARADCOM	Tank Automotive R&D Command
TARCOM	Tank Auto Materiel Readiness Command
TBD	To be determined
TCATA	TRADOC Combined Arms Test Activity
TECOM	Test and Evaluation Command
TFWC	Tactical Fighter Weapon Center
TO&E	Table of Organization & Equipment
TRADOC	Training and Doctrine Command
TRASANA	TRADOC Systems Analysis Activity
TSARCOM	Troop Support & Aviation Materiel Readiness Command

-U-

UGS	Unattended ground sensors
UTM	Universal transverse mercator
UHF	Ultra-high frequency
USAFAS	US Army Field Artillery School
US MIL ACAD	US Military Acadamy

-V-

VHF	Very high frequency

-W-

WES	Waterways Experimentation Station

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